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(PCT Rule 61.2)

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Applicant SUNG, Dan-Keun et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

26 February 2001 (26.02.01)

☐ in a notice effecting later election filed with the International Bureau on:2. The election ☒ was☐ was not

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PATENT COOPERATION TREATY

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NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
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From the INTERNATIONAL BUREAU

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1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address	State of Nationality KR	State of Residence KR
	Telephone No.	
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2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

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3. Further observations, if necessary:

Addition of applicant for all designated States except US.

4. A copy of this notification has been sent to:

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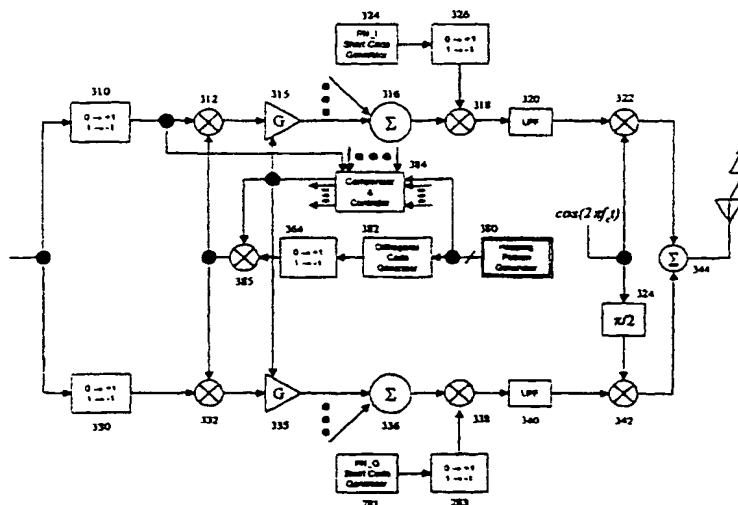
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **METHOD AND APPARATUS FOR ORTHOGONAL CODE HOPPING MULTIPLEXING COMMUNICATIONS**



(57) Abstract: Method and apparatus for statistically multiplexing corresponding channels using an orthogonal code hopping in a wire/wireless communication system in which a plurality of synchronized communication channels coexist through one media. The system including a first communication station and a plurality of second communications includes an orthogonal code hopping pattern generator, a spreader for selecting a corresponding orthogonal code symbol in the orthogonal code, a collision comparator and controller for monitoring whether the orthogonal code symbols collide and determining whether the sent data symbols to the second communication stations coincide in the collision area, a unit for stopping transmission in case of collision of the hopping patterns and discordance of the transmission data symbols, and a transmission power controller for compensating an average receiving energy loss.

**METHOD AND APPARATUS FOR ORTHOGONAL CODE HOPPING
MULTIPLEXING COMMUNICATIONS**

TECHNICAL FIELD

5 The present invention relates to an apparatus and a method for statistically multiplexing channels by using an orthogonal code hopping in a wire/wireless communications system where a plurality of the channels synchronized through one media and having a low data activity coexist. More particularly, the present invention relates to an
10 apparatus and a method in which, in a system having a first communication station and a plurality of second communication stations synchronized with the first communication station, the first communication station recognizes a channel toward each second communication station with an orthogonal code hopping pattern, the
15 orthogonal code hopping pattern of the second communication stations is determined at random, orthogonal code symbols in the hopping patterns of different channels may coincide at an instance (hereinafter, the above coincidence of the orthogonal code symbols is referred as "hopping pattern collision"), the system inspects send data symbols for
20 all send channels of the first communication station related with the collision and makes a corresponding data symbol interval OFF if any channel sends a data symbol not coincident with other channels, and

transmission power of all channels where transmission of the data symbol is OFF as much as an amount and during an interval defined in a communication protocol in order to supplement average bit energy of loss data in all relevant channels.

5

BACKGROUND ART

Descriptions in this application are based on a wireless communication communications system, however the statistical multiplexing suggested in the application may be applied to a wire
10 communications system as well as the wire communications system without any change.

In order to point out clearly which parts or concepts are developed or improved in the present invention in comparison with the prior art, a prior art is described on basis of a communication
15 communications system IS-95, which is already in service.

The first communication station and the second communication in this application are corresponding to a base station and a mobile station in a conventional system. One first communication station communicates with a plurality of second communication stations and
20 the present invention suggests a statistical multiplexing, which may be applied to a synchronized channel group having an orthogonality from the first communication station toward the second communication

stations. For a system, which maintains the orthogonality only for each channel group, such as Quasi-Orthogonal Code (QOC) adapted to Code Division Multiplexing Access (CDMA) 2000, which is one of candidate techniques for the next generation mobile communications system "the IMT-2000 (International Mobile Telecommunications-2000)", the present invention may be independently implemented for each channel group. Moreover, when classifying channels of the first communication station such as sectored or smart antenna systems into channel groups having the same send antenna beam, the present invention may be independently implemented in each channel group.

In the communications method by OCDM (Orthogonal Code Division Multiplexing) adapted by the conventional IS-95 system, the first communication station allocates orthogonal code symbols, which has not been allocated among the orthogonal codes when establishing a call, to one of the second communication stations and the second communication station gives back the allocated orthogonal code symbols to the first communication station when releasing the call such that other second communication stations may use the orthogonal code symbols.

In description of the prior art, same reference number is used for a component having same function as that of the present invention.

FIG. 1 shows a system according to both the prior art and the

present invention. As shown in the figure, each communication channel 121, 122, 123 from the first communication station 101 to the second communication stations 111, 112, 113 is synchronized with maintaining orthogonality.

5 FIG. 2a shows configurations of a transmitter of the first communication station, which corresponds to a common element of the prior art and embodiments of the present invention. FIG. 2b shows configurations of the transmitter of the first communication station for a traffic channel of the prior art.

10 A pilot channel 200 is used as a reference signal for initial synchronous detection and tracking and synchronous decoding in the second communication station of FIG. 1. The pilot channel 200 is commonly used in all second communication stations in an area covered by the first communication station. The pilot channel 200
15 provides a phase reference for the synchronous decoding by transmitting symbols having a known pattern without passing through channel coding and channel interleaving as shown in FIG. 2a.

A synchronous channel 210 is a broadcast channel which is one-sidedly transmitted to all second communication stations in an
20 area covered by the first communication station, like the pilot channel 200. The first communication station transmits information (e.g. visual information, an identifier of the first communication station, etc.),

which the second communication stations commonly require, to the second synchronous channel 210 through the synchronous channel 210. The data from the synchronous channel 210 pass through a convolutional encoder 214, a repeater 216 for adjusting a symbol rate, a block interleaver 218 for correcting an error burst and a repeater 219 for matching a send data symbol rate and are then transmitted to a spreading and modulating unit, shown in FIG. 3 and described below.

A paging channel 220 is a common channel used in case of an incoming message to the second communication station or for answering to a request of the second communication station. A lot of the paging channels 220 can exist. The data transmitted to the paging channel pass through a convolutional encoder 224, a symbol repeater 226 and a block interleaver 228 and passes through an exclusive OR gate 236 together with an output of a long code generator 232 generated by a long code mask 230. The data through the exclusive OR gate 236 is then transmitted to the spreading and modulating unit of FIG. 3.

A traffic channel 240 in FIG. 2b is a channel dedicatedly allocated to each second communication station for use until the call is completed. When there are data to be transmitted to each second communication station, the first communication station transmits the data through the traffic channel 240. The data from the traffic channel 240 passes through a cyclic redundancy check (CRC) 241 for inspecting

an error in a specific time unit, or frame, (e.g. 20ms in IS-95). Tail bits 242 are inserted into the traffic channel, all of which are "0", and the data through the CRC 241 pass through a convolutional encoder 244 for ensuring to independently encoding the channel in a frame unit.

5 The data then pass through a symbol repeater 246 for matching transmission data symbol rate according to a send data rate. After passing through the symbol repeater 246, the data pass through a block interleaver 248 for changing an error burst into a random error. The data passing through the block interleaver 248 are scrambled in a

10 scrambler 256 with use of a pseudo-noise (PN) sequence, generated by passing an output of a long code generator 232 decimated in a decimator 234 with use of a long code mask 250 generated by an electronic serial number (ESN) allocated to each second communication station. A PCB (page control block) position extractor 258 extracts a

15 position where a command for controlling transmission power from the second communication station is inserted in the PN sequence decimated in the decimator 234. A punch and insert 260 punches a data symbol corresponding to the insert position of the power control command extracted by the PCB position extractor 258 among the data

20 symbols scrambled in the scrambler 256 and inserts the power control command, then transmitting the power control command to the spreading and modulating unit in FIG. 3.

FIGs. 3a, 3b and 3c show an embodiment of a spreading and modulating unit according to the prior art.

FIG. 3a corresponds to the commonly used IS-95 method employing BPSK (Binary Phase Shift Keying) as a data modulating method. FIG. 3b shows the spreading and modulating unit employing QPSK (Quadrature Phase Shift Keying) as a data modulating method for transmitting double data in comparison the method in FIG. 3a.

FIG. 3b is adapted the CDMA 2000 method, which is one of candidate techniques for the IMT-2000. FIG. 3c shows a spreading and modulating unit, which employs QOC (Quasi-Orthogonal Code) used in CDMA 2000, which is one of candidate techniques for the IMT-2000. In FIG. 3, signal converters 310, 326, 330, 346, 364 convert logic signals "0" and "1" into physical signal "+1" and "-1" to be really transmitted. Each channel of FIG. 2 passes through the signal converters and is then spread in spreaders 312, 332 by an output of a Walsh code generator 362. Transmission power of each channel is adjusted in amplifiers 314, 334. All channels of the first communication station are spread in spreaders 314, 334 by an orthogonal Walsh function of the Walsh code generator 362 allocated to each channel fixedly. The channels are then amplified in the amplifiers 314, 334 and then pass through QPSK spreading and modulating units 318, 338. Signals spread and modulated in the QPSK spreading and modulating

units 318, 338 are multiplied by a carrier in multipliers 322, 342 to transit to a sending band through low-pass filters (LPF) 320, 340. The signal multiplied by the carrier passes through a radio communication unit and is then transmitted through an antenna, not shown in the
5 figures.

FIG. 3b is identical to FIG. 3a except the fact that, in order to transmit the signal generated in FIG. 2 to QPSK instead of BPSK, different information data are carried in an in-phase channel and a quadrature phase channel through a demultiplexer 390. Using the
10 demultiplexer 390 and the signal converters 310, 330 enables QAM (Quadrature Amplitude Modulation) as well as QPSK.

FIG. 3c shows the case that a QOC mask is used for distinguishing a channel from the first communication station to the second communication stations. Orthogonality is not maintained in a
15 code symbol group using different QOC masks but maintained in a code symbol group using same QOC mask. Therefore, the present invention is applied to the orthogonal code symbol group using same QOC mask, which may maintain the orthogonality.

FIGs. 4a, 4b and 4c shows signals used in the code division
20 multiplexing, which spreads the signal generated in FIG. 2 and FIG. 3 into the orthogonal code symbol fixedly allocated to each channel, according to the prior art. A pilot channel 410 is spread by a fixedly

allocated orthogonal Walsh code symbol $W\#0$ in a spreader 412. Other channels are also spread by orthogonal Walsh code symbols $W\#1$, $W\#2$, ..., $W\#29$, $W\#30$, ..., $W\#63$ fixedly allocated regardless of activities of the corresponding channels. If allocating the orthogonal code symbol
5 fixedly to a channel such as channels 440, 450, 460 having relatively low transmission data activity, utilization of the orthogonal code, which is a limited source, is much less than 100%.

FIG. 4b shows how a despreading data symbol is spread by the orthogonal code. In reference numbers 471 to 477, white areas mean
10 "0[+1]" and black areas mean "1[-1]", for the Walsh code as an example of the orthogonal code.

FIG. 4c shows that the orthogonal code symbols are allocated to each channel in OCDM.

FIG. 5 briefly shows a configuration of a receiver of the second
15 communication station corresponding to the transmitter of the first communication station according to the prior art. As shown in the figure, the signal received through the antenna passes through multipliers 510, 530 for multiplying the signal with a carrier, low pass filters (LPFs) 512, 532 for generating a baseband signal and short code
20 generators 520, 540 for synchronizing the signal with a sequence same as the PN sequence used in the transmitter. The signal then passes through multipliers 514, 534 for multiplying the signal by the received

baseband signal and then despreaders 516, 536 for accumulating the signals during a transmission data symbol area. A channel estimator 550 estimates a transmission channel by extracting only pilot channel components from the baseband signal as the orthogonal code symbol
5 allocated to the pilot channel. A phase recovery 560 compensates phase distortion of the baseband signal with use of an estimated phase distortion value.

FIG. 6 shows a configuration of a receiver for a channel in which a control command for controlling transmission power from the second
10 communication station to the first communication station like the paging channel is not inserted. Referring to the figure, maximum ratio combiners 610, 612 combine signals passing through the phase compensation to a maximum ratio. If the receiver performs QPSK data modulation as shown in FIG. 3b, the receiver performs descrambling by
15 multiplexing the signal in a multiplexer 614, performing soft decision in a soft decision unit 616, then decimating an output of a long code generator 622 generated by a long code mask 620 in a decimator 624, and then multiplying the signal through the soft decision unit with a decimated result of the decimator 624. In the present invention, a
20 configuration of a receiver in the second communication station for the orthogonal code hopping multiplexing is similar to the configuration in FIG. 6. For the synchronous channel, the descrambling processes 620,

622, 624, 626, 628 using the long code may be skipped.

FIG. 7 shows a configuration of a receiver to which a control command for controlling transmission power from the second communication station to the first communication station like the traffic channel. As shown in the figure, the signal enduring the phase compensation in FIG. 5 passes through maximum ratio combiners 710, 712. In case that a receiver performs QPSK data modulation as shown in FIG. 5, a multiplexer 714 multiplexes a in-phase component and an orthogonal phase component in the signal. An extractor 740 extracts a signal component corresponding to the power control command transmitted from the first communication station among the received signal. The signal from the extractor 740 then passes through a hard decision unit 744 and is then transmitted to a transmission power controller of the second communication station. Data symbols except the power control command in the received signal from the multiplexer 714 pass through a soft decision unit 742. A decimator 724 decimates an output of a long code generator 722 generated by a long code mask 720 generated by an identifier of the second communication station. The data symbols from the soft decision unit 742 is then multiplied in a multiplier 718 by a result of the decimator 724, so to perform descrambling.

FIG. 8 shows a function of recovering the received signal through

the signal processes of FIG. 6 and FIG. 7 from the first communication station, through block deinterleavers 818, 828, 838 and convolutional decoders 814, 824, 834. In a synchronous channel 810, in order to lower a symbol rate, a sampler 819 performs symbol compression for the signals through the soft decision unit by accumulating the signals, which is an inverse process to the symbol repeater 219. The signal through the sampler 819 passes through a block deinterleaver 818. Then, a sampler 816 performs symbol compression again for the signal, which is an inverse process to the symbol repeater 216, before the signal passes to a convolutional decoder 814. The signal passing enduring the symbol compression then passes through the convolutional decoder 814, then recovering the synchronous channel transmitted from the first communication station.

In case of a paging channel 820, the signal enduring the soft decision passes through a block deinterleaver 828 for channel interleaving. The signal enduring the channel interleaving passes through a sampler 826 for symbol compression according to the send data rate, which is an inverse process of the symbol repeater 226. The signal enduring the symbol compression passes through a convolution decoder 824 for channel decoding, so recovering the paging channel transmitted from the first communication station.

In case of a traffic channel 830, the signal enduring the soft

decision passes through a block deinterleaver 838 for performing channel deinterleaving regardless of a send data rate. The signal enduring the channel interleaving passes through a sampler 836 for performing symbol compression according to the send data rate, which
5 is an inverse process to the symbol repeater 246. A convolutional decoder 834 performs channel decoding for the signal enduring the symbol compression. A tail bit remover 832 removes tail bits of the signal used for independent send signal generation in a frame unit. A CRC 831 generates a CRC bit for the send data portion like the
10 transmitter and inspects errors by comparison with a recovered CRC after channel decoding. If the two CRC bits coincides, the CRC 831 determines that there is no error and then the traffic channel data are recovered. If the transmitter does not include information about the send data rate in 20ms frame unit, the send data rate of the first
15 communication station may be determined by channel-decoding the signals enduring the independent channel deinterleaving and comparing the CRC bits. A system, which transmits a send data rate independently, just further requires a channel decoding process corresponding to the data rate.

20 In case of spreading the despreading data symbol by fixedly using the orthogonal code allocated when establishing a call as shown in FIG. 3 in order to maintain orthogonality between channels from the first

communication station to the second communication station as shown in FIG. 1, the orthogonal code, limited source, may not be efficiently used for send data having relatively low activity such as data indicated by reference numbers 440, 450 and 460 in FIG. 4a. In order to
5 increase activity of the orthogonal code with fixed allocation, rapid channel allocation and return are required. However, if transmitting the control signal information for channel allocation and return more frequently, more significant amounts of limited frequency resources should be used for the control information of data transmission, not for
10 data transmission itself. Moreover, however rapid the channel allocation and return are processed, there should be a buffering process after the data to be transmitted reaches at the first communication station till transmitted in order to transmit a channel allocation (or return) message and respond to the message. As time for such
15 processes is extended, more capacity is required in the buffer. Information, which requires checking whether the information is transmitted normally, should be buffered for retransmission. However, in case of transmitting information without checking normal transmission of the information, such as, in a datagram method, a
20 delay should be minimized in an allowable range in order to decrease the capacity of the buffer.

Therefore, while the prior art allocates the orthogonal codes in a

fixed manner so to have 1:1 relation between the orthogonal code and the channel, the present invention, with a little modification of the prior art, performs statistical multiplexing for traffic channels having low activities in consideration of activity of the send data in order to
5 increase activities of the orthogonal codes, which are limited resources, and eliminates unnecessary channel allocating and returning processes in order to decrease buffer capacity and data transmission delay.

DISCLOSURE OF INVENTION

10 The present invention is designed to overcome the above problems of the prior art. An object of the invention is to decrease waste of resources caused by transmission of unnecessary control signals, minimize a required capacity of a buffer in a first communication station used for time division multiplexing and reduce a data
15 transmission delay by means of utilizing the limited resources efficiently with use of a statistical multiplexing method, namely orthogonal code hopping multiplexing, when synchronized channels maintaining orthogonality have low activities, and performing spreading or despreading according to a hopping pattern of each transmitter and
20 receiver by skipping unnecessary channel allocating and returning processes.

In order to accomplish the above object, the present invention

provides a method for orthogonal code hopping multiplexing communications in a band spreading communications system, which performs statistical multiplexing for communication channels from a first communication station to second communication stations by
5 orthogonal code hopping multiplexing communications.

The channels from the first communication station to a plurality of the second communication stations may be synchronized to distinguish the channels by using orthogonality.

The method may include a further step of distinguishing the
10 channels from the first communication station to the second communication stations with use of orthogonal code hopping patterns.

The orthogonal code may be a Hadamard code, a variable spreading factor code or a gold code.

The method may include a further step of allocating the
15 orthogonal code hopping pattern to the second communication stations dedicatedly.

It is preferred that the orthogonal code hopping pattern is allocated to the second communication stations from the first communication station when starting communication, and the second
20 communication stations give back the orthogonal code hopping pattern when the communication is completed.

The method may include a further step of performing the

orthogonal code hopping multiplexing for a channel among the channels, which has a low transmission data activity.

The method may include a further step of transmitting a command for controlling transmission power of the second communication stations with use of a separate common power control channel of the first communication station.

The transmission power control command of each second communication station in the common power control channel can be time-multiplexed and may employ a collision-resistant hopping pattern for preventing collision of the hopping pattern.

The collision-resistant hopping pattern may include a fixed orthogonal code symbol allocation like a code division multiplexing.

The orthogonal code hopping patterns for the statistical multiplexing may be generated at random or with use of a pseudo-noise sequence generator.

A plurality of the orthogonal code hopping patterns for the statistical multiplexing are allocable to one of the second communication stations according to a send data rate of the first communication station.

Each of the orthogonal code hopping patterns may hop independently in the orthogonal code hopping multiplexing communications.

The orthogonal code hopping patterns may hop not to generate collision each other in the orthogonal code hopping multiplexing communications and may be periodically repeated in a frame unit.

The frame unit is an independent data unit based on channel
5 encoding.

The first communication station may detect a hopping pattern collision caused by the random orthogonal code hopping patterns in advance in order not to transmit a corresponding despreading data symbol.

10 The method may include a further step of comparing despreading data symbols at time of a hopping pattern collision caused by the random orthogonal code hopping patterns in order to transmit the data symbols in case that all of the data symbols are same.

The method may include a further step of comparing despreading
15 data symbols at time of a hopping pattern collision caused by the random orthogonal code hopping patterns in order not to transmit the data symbols in case that the data symbols are not same.

The method may include a further step of increasing transmission power of a data symbol next to the data symbols, which are not
20 transmitted because of discordance of the despreading data symbols at time of the hopping pattern collision.

It is also preferred that the transmission power is increased as

much as an amount given by a system parameter during a period given by a system parameter.

The two system parameters may be position functions of the not-transmitted despread data symbols and preferably at least 0.

5 Preferably, the hopping pattern collision is prevented only when there is a possibility that sending antenna beams of the first communication station, where the hopping patterns are collided, are superposed so to cause a serious error in a channel decoding process of the second communication station.

10 A pilot signal can be used for initial synchronous gain and tracking of the channels and synchronous decoding of the channels owing to phase distortion compensation.

The pilot signal may employ a non-collision hopping pattern for preventing a loss of the phase distortion compensation ability due to
15 collision.

The non-collision hopping pattern may include a fixed orthogonal code symbol allocation like the code division multiplexing.

In order to obtain the above object, the present invention provides a transmitter in a band spreading communications system including a
20 first communication station and a second communication station, the transmitter comprising a channel encoder for coding a channel; an orthogonal code hopping pattern generator for generating an orthogonal

code hopping pattern; an orthogonal code generator for generating an orthogonal code symbol according to the hopping pattern; and an orthogonal code collision detector for detecting collision of the hopping patterns.

- 5 The transmitter may further include an interrupter for interrupting a send signal according to output of the orthogonal code collision detector.

 The orthogonal code collision detector may include a despreading data symbol comparator for comparing that all of despreading data
10 symbols of corresponding channels are same at time of a hopping pattern collision; and the interrupter may interrupt transmission of the sending signal in case that the corresponding despreading data symbols are not same as a comparison result of the despreading data symbol separator.

- 15 In order to accomplish the above object, the present invention provides a receiver in a band spreading communications system including a first communication station and second communication stations, the receiver comprising a channel decoder for decoding a channel; an orthogonal code hopping pattern generator for generating
20 an orthogonal code hopping pattern; and an orthogonal code generator for generating an orthogonal code symbol according to the hopping pattern.

In order to perform the above object, the present invention also provides a method for band spreading communications in a band spreading communications system using orthogonal codes, the method comprising the step of dividing the orthogonal codes into a first
5 orthogonal code symbol group for code division multiplexing and a second orthogonal code symbol group for statistical multiplexing owing to orthogonal code hopping.

The method may include a further step of performing the code division multiplexing by fixedly allocating the orthogonal code symbols
10 in the first orthogonal code symbol group to a channel having a high data activity in communications.

The method may include a further step of performing orthogonal code hopping multiplexing for a channel having a low data activity according to the orthogonal code hopping pattern by using only the
15 orthogonal code symbols in the second orthogonal code symbol group.

The orthogonal code may be an orthogonal variable spreading factor code.

Preferably, the first orthogonal code symbol group consists of child codes generated from one parent code in a hierarchical orthogonal
20 code generating tree structure according to the variable spreading factors, while the second orthogonal code symbol group consists of remained orthogonal code symbols.

The first orthogonal code symbol group used for the code division multiplexing may be selected to have a variable spreading gain according to a send data rate.

5 The channel for the orthogonal code hopping multiplexing may have a fixed data rate, and the method may include a further step of selecting orthogonal code symbols having the same spreading factor in the second orthogonal code symbol group.

BRIEF DESCRIPTION OF THE DRAWINGS

10 These and other features, aspects, and advantages of preferred embodiments of the present invention will be more fully described in the following detailed description, taken accompanying drawings. In the drawings:

FIG. 1 shows a concept of a system having a first communication station and second communication stations according to both the prior art and the present invention;

FIG. 2a shows a configuration of a transmitter in the first communication station, which is a common component of the prior art and the present invention;

20 FIG. 2b shows a configuration of a transmitter for traffic channels in the first communication station according to the prior art;

FIG. 3a shows a configuration of a receiver in the first

communication station using a CDMA method in case of BPSK data modulation according to the prior art;

FIG. 3b shows a configuration of a receiver in the first communication station using a CDMA method in case of QPSK data modulation according to the prior art;

FIG. 3c shows a configuration of a receiver in the first communication station using a CDMA method in case of using QOC data according to the prior art;

FIG. 4a shows a send signal of the first communication station according to the prior art;

FIG. 4b shows an orthogonal code for distinguishing channels according to the prior art;

FIG. 4c shows the CDMA according to the prior art;

FIG. 5 shows a configuration of a receiver in the second communication station in the CDMA method according to the prior art;

FIG. 6 shows a configuration of common components of the receiver in the second communication station according to the prior art and the present invention;

FIG. 7 shows a configuration of the receiver in the second communication station in FIG. 4b;

FIG. 8 shows a configuration of common components of the receiver according to the prior art and the present invention;

FIG. 9 shows a configuration of a transmitter in the first communication station about traffic channels for orthogonal code hopping multiplexing and a configuration of a common power control channel for the traffic channels;

5 FIG. 10a shows a configuration of a transmitter in the first communication station using the orthogonal code hopping multiplexing according to the present invention, corresponding to FIG. 4a;

FIG. 10b shows a configuration of a transmitter in the first communication station using the orthogonal code hopping multiplexing
10 according to the present invention, corresponding to FIG. 4b;

FIG. 10c shows a configuration of a transmitter in the first communication station using the orthogonal code hopping multiplexing according to the present invention, corresponding to FIG. 4c;

FIG. 11 shows a configuration of an orthogonal code hopping
15 pattern generator according to the present invention;

FIG. 12a shows an example of an orthogonal variable spreading factor code according to the present invention;

FIG. 12b shows an orthogonal gold code generator according to the present invention;

20 FIG. 13 shows a configuration of a receiver in the second communication station in the orthogonal code hopping multiplexing of FIG. 10b according to the present invention;

FIG. 14a shows a send signal when using the code division multiplexing for traffics toward the second communication station having relatively high send data activities;

FIG. 14b shows a send signal when using the orthogonal code hopping multiplexing for traffics toward the second communication station having relatively low send data activities;

FIG. 14c shows the orthogonal spreading code of the present invention;

FIG. 14d shows the code division multiplexing of FIG. 14a according to the present invention;

FIG. 14e shows the statistical multiplexing by the orthogonal code hopping multiplexing of FIG. 14b according to the present invention;

FIG. 14f shows hopping pattern collisions in case of the orthogonal code hopping multiplexing of FIG. 14b according to the present invention;

FIG. 14g shows transmission stopping in the collision area of relevant channels when the hopping patterns collide and send data symbols do not match as shown in FIG. 14f;

FIG. 14h shows the process of increasing transmission power of the first communication station in a certain area after a data symbol not transmitted in order to compensate average receiving energy required for a channel decoder for satisfied communication quality

when stopping transmission in the hopping pattern collision area in FIG. 14g; and

FIG. 15 is a diagram for illustrating that transmission stopping caused by the hopping pattern collision and mismatch of the send data symbols is independently operated for each send antenna beam of the first communication station.

BEST MODES FOR CARRYING OUT THE INVENTION

Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings.

In this application, similar reference numbers are used for components similar to the prior art and only modified or added components in comparison with the prior art are described for the present invention in detail.

FIG. 9 is a modified one of the traffic channel of the prior art for performing orthogonal code hopping multiplexing in case of having a low send data activity, which is identical to the prior art except that a transmission power control command for the second communication station is inserted. Communication is divided into bi-directional communication and one-directional communication, in which the one-directional communication does not need the transmission power

control command for the second communication station.

However, in case of the bi-directional communication, the transmission power control command is required in order to maximize system capacity through effective power control. For improving a processing rate, the power control command does not endure channel coding in most cases. A random orthogonal code hopping pattern inevitably causes collisions between each other channels. Therefore, it is required to transmit the power control command to a channel in which a collision is generated. In this point, a concept of a common power control channel adapted in CDMA 2000, which is one of candidate techniques for the IMT-2000, may be introduced. The common power control channel is spread by a separate orthogonal code symbol such as the pilot channel and transmitted by the time division multiplexing for a plurality of the second communication stations. A position of the power control command for each second communication station is allocated in a call establishing process. FIG. 9 shows an embodiment of the common power control channel for controlling 24 second communication stations.

FIGs. 10a, 10b and 10c show embodiments to which characteristics of the present invention are applied to the prior art shown in FIGs. 3a, 3b and 3c. For statistical multiplexing by the orthogonal code hopping multiplexing suggested in the present

invention, required are an orthogonal code hopping pattern generator 380 and collision comparator & controller 384, 386 for suitable control by detecting collisions of the orthogonal code symbols generated by the random hopping pattern generation. An example of the orthogonal code hopping pattern generator is shown in FIG. 11, which has a configuration for generating the hopping pattern with use of a general PN sequence generator. There is required an orthogonal code generator 382 for generating a spreading orthogonal code symbol according to the hopping pattern generator 380. The orthogonal code generated in the orthogonal code generator 382 may be an orthogonal variable spreading factor (OVSF) having a hierarchical structure which can be a Walsh code for a specific spreading factor as shown in FIG. 12a, or an orthogonal gold code generated by an orthogonal gold code generator as shown in FIG. 12b. Any orthogonal code maintaining orthogonality is possible.

When an output of the orthogonal code hopping pattern generator 380 is constant, the present invention equals to the orthogonal code division multiplexing identical to the prior art. That is, the orthogonal code division multiplexing of the prior art is a subset of the orthogonal code hopping multiplexing of the present invention. Therefore, after dividing one orthogonal code into two orthogonal code symbol groups, one orthogonal code group is used for an orthogonal code hopping

multiplexing using fixed allocation and the other orthogonal code group is used for an orthogonal code hopping multiplexing using a hopping pattern.

Or else, one orthogonal code symbol group among the two divided
5 orthogonal code symbols performs the orthogonal code hopping multiplexing with use of a hopping pattern intentionally selected to prevent collision of the hopping patterns, while the other orthogonal code symbol group performs the orthogonal code hopping multiplexing by the statistical multiplexing with use of a hopping selected randomly
10 in which a collision between the hopping patterns may happen.

In the two cases, it is preferred that the former is allocated to a channel having a relatively high send data activity and the later is allocated to a channel having a relatively low send data activity. In case of using a hierarchical orthogonal code supporting a variable
15 spreading gain as a spreading code as shown in FIG. 12a, it is preferred to divide the orthogonal code into orthogonal code symbol groups 393, 397 consisting of all child code symbols having same parent code symbol 391, 395 such as "01" or "0110" because it may support the variable spreading gain. As described above in brief, if the orthogonal
20 code hopping pattern generator intentionally generates the orthogonal code hopping patterns not to select different channels at same orthogonal code symbol in the same instant, no collision generates.

However, such method has disadvantages that the hopping pattern should be allocated by the first communication station in establishing a call and that number of the hopping patterns allocated by the first communication station is limited by a size of the orthogonal code. In this case, because the statistical multiplexing according to the data activity of each channel is not possible, hopping patterns are allocated to each channel independently and at random. In this reason, orthogonal code patterns, which select the same orthogonal code symbol at the same instant, make a collision inevitably. Therefore, the present invention receives hopping patterns of each channel and despreads data symbols to be transmitted and determines whether the hopping patterns collide with use of the collision comparator & controller 384, 386 for overcoming such problems. Besides that, the present invention compares whether the despreads data symbols of all channels corresponding to the collisions are all same.

In case that all despreads data symbols match, the data symbols in the collision area are spread and transmitted. It is because the data symbol may cause an error in the channel decoding process. However, if there is one data symbol not matched, the data symbol in the collision area of the corresponding channel is not transmitted. That is, according to a result of the collision comparator & controller 384, 386, an input of the multipliers 385, 387 becomes "+1" or "0". In

the area that the input of the multiplier is "0", the transmission is stopped.

In order to compensate deficiency of an average receiving energy in the second communication station due to transmission stop of the despreading data symbol for satisfied quality, a gain of amplifiers 315, 335 of the corresponding channel is adjusted as much as a size given by a system parameter during an area given by a system parameter like the reference numbers 1072, 1074 in FIG. 14h, then increasing the transmission power of the first communication station. Regardless of the above process, the transmission power control for the first communication station is performed according to the method of the prior art.

FIGs. 14a to 14h show concepts of a send signal of the first communication station according to the present invention. FIG. 14a shows a send signal in case of performing the code division multiplexing by fixedly allocating the orthogonal code symbols to a channel which transmits data having a relatively high activity. FIG. 14b shows a send signal in case of performing the orthogonal code hopping multiplexing to select a spreading orthogonal code symbol according to hopping patterns $H_1[n]$, $H_2[n]$, $H_3[n]$, ..., $H_M[n]$ for a channel which transmits data having a relatively low activity. The number of the hopping patterns may be over a size of the orthogonal code. Because the

hopping patterns may cause collision when generating the hopping patterns at random, it is preferred that the orthogonal code symbols are fixedly allocated as designated by a reference number 912 to a pilot channel 910 used as a phase reference for the synchronous demodulation and a channel not enduring channel coding such as the common power control channel of FIG. 9, while the orthogonal code hopping multiplexing is performed with use of remained orthogonal code symbols.

It is also preferred to use the statistical multiplexing by the orthogonal code hopping multiplexing in a data area and not to use the orthogonal code hopping multiplexing in a pilot area not only when the pilot channel exists in the code division multiplexing method but also when performing the time division multiplexing for the pilot signal like W-CDMA (Wideband Code Division Multiple Access), another candidate technique of the IMT-200 system. In the send data area, the orthogonal code symbol used in the pilot area may be also used.

If the send antenna beams from the first communication station are different according to positions of the second communication stations such as smart antenna, the pilot signals are separately managed for each antenna beam. In addition, in an asynchronous modulation/demodulation system, which does not use the pilot signal and does not require the pilot signal, the orthogonal code hopping

multiplexing is performed with use of all orthogonal code symbols in the orthogonal code.

FIG. 14c shows an example of the orthogonal code symbol used for spreading the despread data symbol according to the present invention. As shown in the figure, it will be easily known that a symbol of this embodiment has no difference from the prior art in FIG. 4b except the case that a different orthogonal code is used.

FIG. 14d shows a case of fixedly allocating the orthogonal code symbols to each channel having a high send data activity similar to the prior art.

FIG. 14e shows the orthogonal code hopping multiplexing according to the present invention, in which the hopping channels in each channel 1011, 1012, 1013, 1014, 1015, 1016, 1017 do not collide in all symbol areas 1021, 1022, 1023, 1024, 1025, 1026, 1027, 1028. However, in case of performing the orthogonal code hopping multiplexing as shown in FIG. 14h, it can be seen that the hopping patterns collide in the symbol areas 1041, 1043, 1046. In a time area 1041, the hopping patterns collide but the despread data symbols coincide (shown with double-line box). Time areas 1043, 1046 is a case that the despread data symbols do not coincide. Through the hopping patterns collide in the time areas 1043, 1046 as shown in FIG. 14g. however, in the case of time area 1061 where the send data

symbols coincide, corresponding desreading data symbols are spread and transmitted, while in the case of time areas 1063, 1066 where the send data symbols do not coincide, transmission of all relevant channel is stopped.

5 Such channel stop is carried out for the channel group existing in same send antenna beam from the first communication station. In case that a plurality of send antenna beams 1120, 1130, 1140 from the first communication station such as a smart antenna exist, the transmission is not stopped for channels 1132, 1142, 1144 in
10 non-overlapped send antenna beams 1130, 1140 though the hopping patterns collide.

FIG. 14h shows the process of increasing transmission power as much as a regulated amount during a regulated time in order to satisfy an average receiving signal energy in the second communication station
15 required for communication quality after an area where the transmission is stopped due to collision of the hopping patterns and discordance of the desreading data symbols as described above in brief, similar to FIG. 14g.

As described in embodiments of the present invention, if
20 performing the orthogonal code hopping multiplexing with random hopping patterns, the send data may be intentionally lost in an area where the hopping patterns collide. Therefore, in order to recover the

data existing in the loss area in the receiver, it is essential that the transmitter performs the channel encoding and the receiver performs the channel decoding.

The statistical multiplexing of the present invention may be used
5 in combination with other multiplexing methods such as a time division multiplexing, a frequency division multiplexing, a space division multiplexing, etc.

In addition, as a development of the orthogonal code division multiplexing system using a multi-code method, a plurality of channels
10 may be allocated to one second communication station with use of a plurality of hopping patterns, which may realize a rapid send data rate. At this time, in allocating the multiple hopping patterns, the hopping patterns of each channel are generated as described above.

As described above, the present invention employs the statistical
15 multiplexing method, namely the orthogonal code hopping multiplexing, in case that synchronized channels maintaining orthogonality have low activities, which may enable to use limited resources efficiently and increase less complexity than the prior art. The receiver particularly needs no increase of hardware except the orthogonal code hopping
20 pattern generator. In addition, because the receiver and the transmitter perform spreading and despreading according to the respective hopping patterns without any process for excessive channel

allocation or return for a traffic having a low activity from the first communication station to the second communication, the present invention may decrease waste of resources due to, such as, unnecessary control signal transmission and reduce buffer capacity and data transmission delay caused by scheduling of the send data of the first communication.

Moreover, the present invention may distinguish nearly unlimited number of channels (if the hopping pattern has a period in a frame unit, near $64^{19.2\text{kps}} \times 20\text{ms} = 64^{384}$ of channels on basis of IS-95 system) when selecting the hopping patterns at random in comparison to the method of allocating the spreading orthogonal code symbols fixedly. Furthermore, though there occurs collision between the spreading orthogonal code symbols due to the random selection of the hopping patterns, there is no need to stop transmission of the colliding despread data symbol in case that the second communication station exists in an area where send antenna beams of, such as, a sectored antenna and a smart antenna are not overlapped. In addition, the data symbols, which is not transmitted due to the hopping pattern collision between channels in same send antenna beam, may be recovered in the channel decoding process of the second communication station without informing to the second communication station.

The concept of the present invention may be applied to each carrier code group and each quasi-orthogonal code group in systems using a multiple carrier transmission method, a quasi-orthogonal code, etc. to realize the statistical multiplexing.

5

What is claimed is:

1. A method for orthogonal code hopping multiplexing communications in a band spreading communications system, the
5 method comprising the step of:

performing statistical multiplexing for communication channels from a first communication station to second communication stations by orthogonal code hopping multiplexing communications.

10 2. The method for orthogonal code hopping multiplexing communications as claimed in claim 1,

wherein the channels from the first communication station to a plurality of the second communication stations are synchronized to distinguish the channels by using orthogonality.

15

3. The method for orthogonal code hopping multiplexing communications as claimed in claim 1, further comprising the step of:

distinguishing the channels from the first communication station to the second communication stations with use of orthogonal code
20 hopping patterns.

4. The method for orthogonal code hopping multiplexing

communications as claimed in claim 2, further comprising the step of:

distinguishing the channels from the first communication station to the second communication stations with use of orthogonal code hopping patterns.

5

5. The method for orthogonal code hopping multiplexing communications as claimed in one of claims 1 to 4,

wherein the orthogonal code is a Hadamard code.

10

6. The method for orthogonal code hopping multiplexing communications as claimed in one of claims 1 to 4,

wherein the orthogonal code is a variable spreading factor code.

15

7. The method for orthogonal code hopping multiplexing communications as claimed in one of claims 1 to 4,

wherein the orthogonal code is a gold code.

20

8. The method for orthogonal code hopping multiplexing communications as claimed in one of claims 3 and 4, further comprising the step of:

allocating the orthogonal code hopping pattern to the second communication stations dedicatedly.

9. The method for orthogonal code hopping multiplexing communications as claimed in one of claims 3 and 4,

wherein the orthogonal code hopping pattern is allocated to the
5 second communication stations from the first communication station when starting communication, and the second communication stations give back the orthogonal code hopping pattern when the communication is completed.

10 10. The method for orthogonal code hopping multiplexing communications as claimed in one of claims 3 and 4, further comprising the step of:

performing the orthogonal code hopping multiplexing for a channel among the channels, which has a low transmission data
15 activity.

11. The method for orthogonal code hopping multiplexing communications as claimed in one of claims 3 and 4, further comprising the step of:

20 transmitting a command for controlling transmission power of the second communication stations with use of a separate common power control channel of the first communication station.

12. The method for orthogonal code hopping multiplexing communications as claimed in claim 11,,

wherein the transmission power control command of each second
5 communication station in the common power control channel is time-multiplexed and employs a collision-resistant hopping pattern for preventing collision of the hopping pattern.

13. The method for orthogonal code hopping multiplexing
10 communications as claimed in claim 12,

wherein the collision-resistant hopping pattern includes a fixed orthogonal code symbol allocation like a code division multiplexing.

14. The method for orthogonal code hopping multiplexing
15 communications as claimed in one of claims 3 and 4,

wherein the orthogonal code hopping patterns for the statistical multiplexing is generated at random.

15. The method for orthogonal code hopping multiplexing
20 communications as claimed in claim 14,

wherein the random code hopping patterns are generated with use of a pseudo-noise sequence generator.

16. The method for orthogonal code hopping multiplexing communications as claimed in one of claims 3 and 4,

wherein a plurality of the orthogonal code hopping patterns for
5 the statistical multiplexing are allocable to one of the second communication stations according to a send data rate of the first communication station.

17. The method for orthogonal code hopping multiplexing
10 communications as claimed in claim 16,

wherein each of the orthogonal code hopping patterns hops independently in the orthogonal code hopping multiplexing communications.

18. The method for orthogonal code hopping multiplexing
15 communications as claimed in claim 16,

wherein the orthogonal code hopping patterns hop not to generate collision each other in the orthogonal code hopping multiplexing communications.

20

19. The method for orthogonal code hopping multiplexing communications as claimed in one of claims 3 and 4,

wherein the orthogonal code hopping patterns are periodically repeated in a frame unit.

20. The method for orthogonal code hopping multiplexing
5 communications as claimed in claim 19,

wherein the frame unit is an independent data unit based on channel encoding.

21. The method for orthogonal code hopping multiplexing
10 communications as claimed in claim 14,

wherein the first communication station detects a hopping pattern collision caused by the random orthogonal code hopping patterns in advance in order not to transmit a corresponding despread data symbol.

15

22. The method for orthogonal code hopping multiplexing communications as claimed in claim 14, further comprising the step of:

comparing despread data symbols at time of a hopping pattern collision caused by the random orthogonal code hopping patterns in
20 order to transmit the data symbols in case that all of the data symbols are same.

23. The method for orthogonal code hopping multiplexing communications as claimed in claim 14, further comprising the step of:

comparing despread data symbols at time of a hopping pattern collision caused by the random orthogonal code hopping patterns in order not to transmit the data symbols in case that the data symbols are not same.

24. The method for orthogonal code hopping multiplexing communications as claimed in claim 23, further comprising the step of:

increasing transmission power of a data symbol next to the data symbols, which are not transmitted because of discordance of the despread data symbols at time of the hopping pattern collision.

25. The method for orthogonal code hopping multiplexing communications as claimed in claim 24,

wherein the transmission power is increased as much as an amount given by a system parameter during a period given by a system parameter.

26. The method for orthogonal code hopping multiplexing communications as claimed in claim 25,

wherein the two system parameters are position functions of the

not-transmitted despread data symbols.

27. The method for orthogonal code hopping multiplexing communications as claimed in claim 26,

5 wherein the two system parameters are at least 0.

28. The method for orthogonal code hopping multiplexing communications as claimed in one of claims 21 to 27,

wherein the hopping pattern collision is prevented only when
10 there is a possibility that sending antenna beams of the first communication station, where the hopping patterns are collided, are superposed so to cause a serious error in a channel decoding process of the second communication station.

15 29. The method for orthogonal code hopping multiplexing communications as claimed in claim 28,

wherein a pilot signal is used for initial synchronous gain and tracking of the channels and synchronous decoding of the channels owing to phase distortion compensation.

20

30. The method for orthogonal code hopping multiplexing communications as claimed in claim 29,

wherein the pilot signal employs a non-collision hopping pattern for preventing a loss of the phase distortion compensation ability due to collision.

5 31. The method for orthogonal code hopping multiplexing communications as claimed in claim 30,

wherein the non-collision hopping pattern includes a fixed orthogonal code symbol allocation like the code division multiplexing.

10 32. A transmitter in a band spreading communications system including a first communication station and a second communication station, the transmitter comprising:

a channel encoder for coding a channel;

15 an orthogonal code hopping pattern generator for generating an orthogonal code hopping pattern;

an orthogonal code generator for generating an orthogonal code symbol according to the hopping pattern; and

an orthogonal code collision detector for detecting collision of the hopping patterns.

20

33. The transmitter as claimed in claim 32, further comprising an interrupter for interrupting a send signal according to output of the

orthogonal code collision detector.

34. The transmitter as claimed in claim 33,

wherein the orthogonal code collision detector includes a
5 despread data symbol comparator for comparing that all of
despread data symbols of corresponding channels are same at time
of a hopping pattern collision; and

wherein the interrupter interrupts transmission of the sending
signal in case that the corresponding despread data symbols are not
10 same as a comparison result of the despread data symbol separator.

35. A receiver in a band spreading communications system
including a first communication station and second communication
stations, the receiver comprising:

15 a channel decoder for decoding a channel;

an orthogonal code hopping pattern generator for generating an
orthogonal code hopping pattern; and

an orthogonal code generator for generating an orthogonal code
symbol according to the hopping pattern.

20

36. A method for band spreading communications in a band
spreading communications system using orthogonal codes, the method

comprising the step of:

dividing the orthogonal codes into a first orthogonal code symbol group for code division multiplexing and a second orthogonal code symbol group for statistical multiplexing owing to orthogonal code hopping.

37. The method for band spreading communications as claimed in claim 36, further comprising the step of:

performing the code division multiplexing by fixedly allocating the orthogonal code symbols in the first orthogonal code symbol group to a channel having a high data activity in communications.

38. The method for band spreading communications as claimed in claim 36, further comprising the step of:

performing orthogonal code hopping multiplexing for a channel having a low data activity according to the orthogonal code hopping pattern by using only the orthogonal code symbols in the second orthogonal code symbol group.

39. The method for band spreading communications as claimed in claim 36,

wherein the orthogonal code is an orthogonal variable spreading

factor code.

40. The method for band spreading communications as claimed
in one of claims 36 to 39,

5 wherein the first orthogonal code symbol group consists of child
codes generated from one parent code in a hierarchical orthogonal code
generating tree structure according to the variable spreading factors;
and

 wherein the second orthogonal code symbol group consists of
10 remained orthogonal code symbols.

41. The method for band spreading communications as claimed
in one of claims 36 to 39,

 wherein the first orthogonal code symbol group used for the code
15 division multiplexing is selected to have a variable spreading gain
according to a send data rate.

42. The method for band spreading communications as claimed
in claim 40,

20 wherein the first orthogonal code symbol group used for the code
division multiplexing is selected to have a variable spreading gain
according to a send data rate.

43. The method for band spreading communications as claimed
in one of claims 36 to 39,

wherein the channel for the orthogonal code hopping multiplexing
5 has a fixed data rate,

the method further comprising the step of selecting orthogonal
code symbols having the same spreading factor in the second
orthogonal code symbol group.

10 44. The method for band spreading communications as claimed
in claim 40,

wherein the channel for the orthogonal code hopping multiplexing
has a fixed data rate,

the method further comprising the step of selecting orthogonal
15 code symbols having the same spreading factor in the second
orthogonal code symbol group.

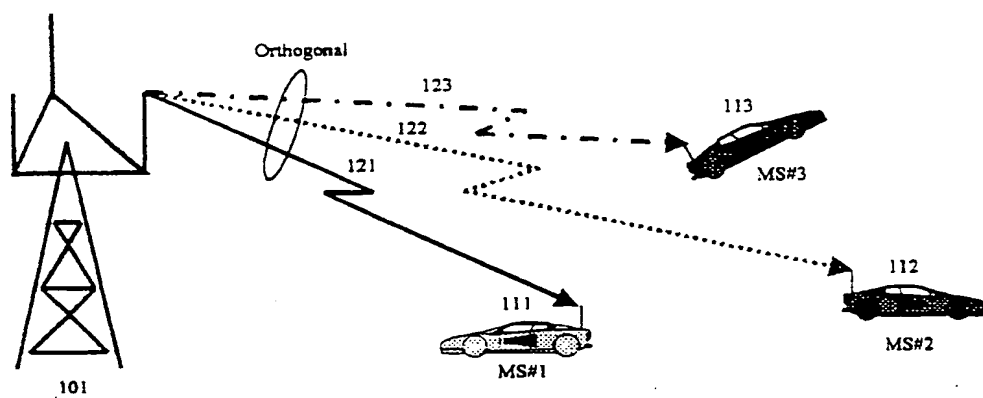


FIG. 1

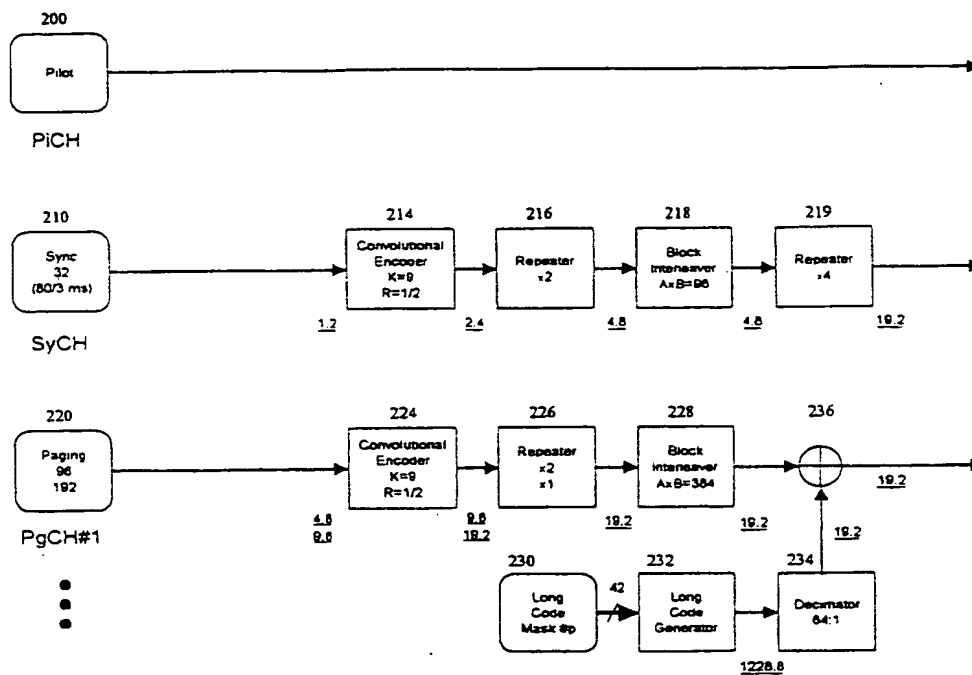


FIG. 2a

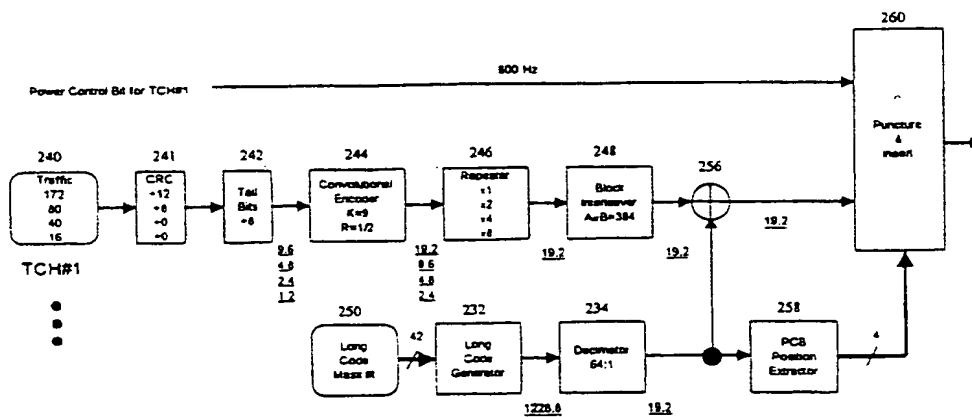


FIG. 2b

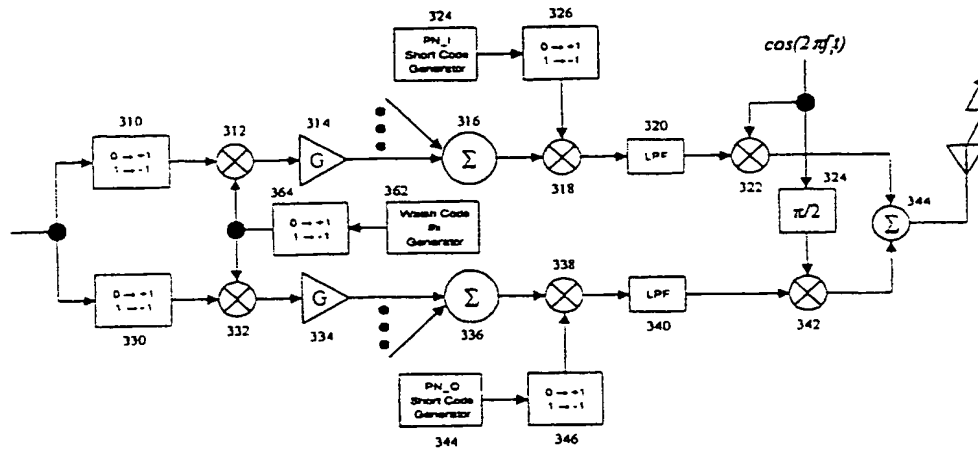


FIG. 3a

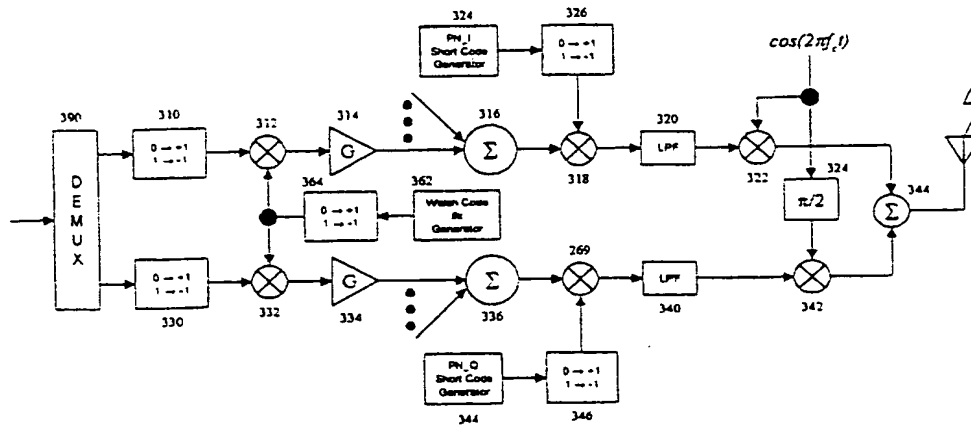


FIG. 3b

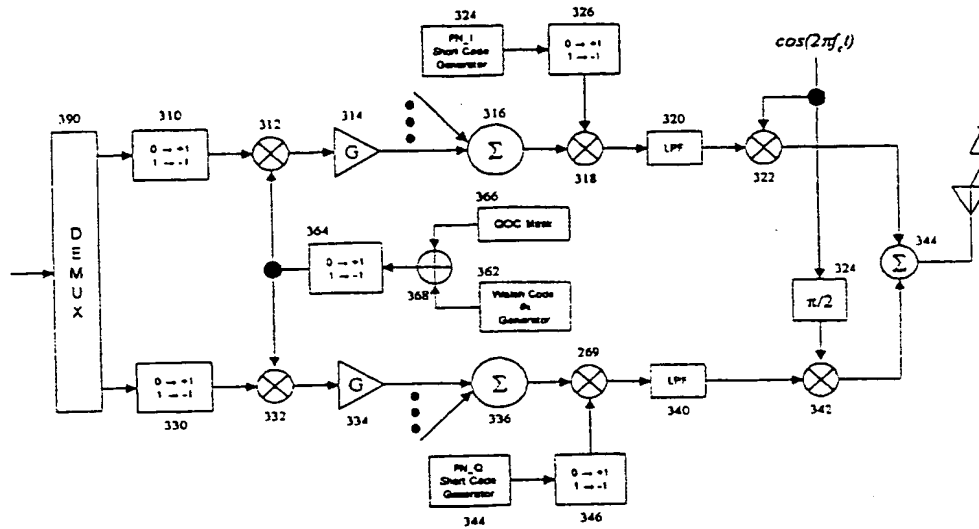


FIG. 3c

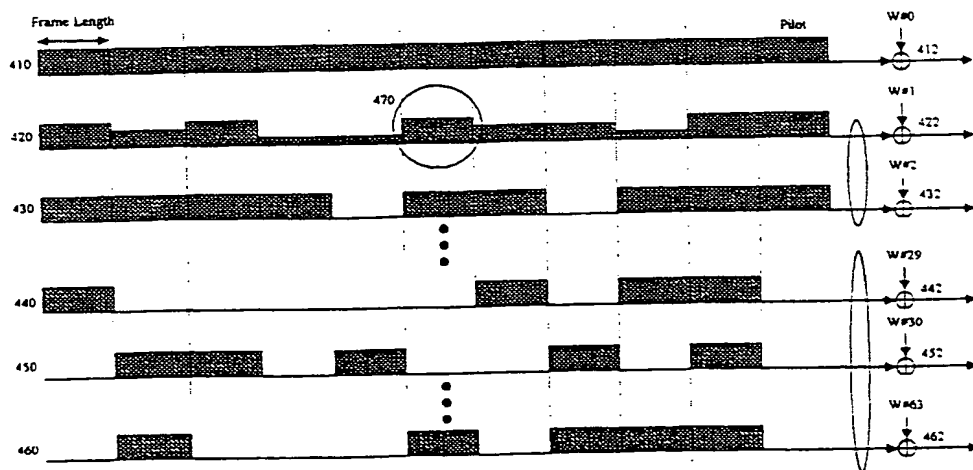


FIG. 4a

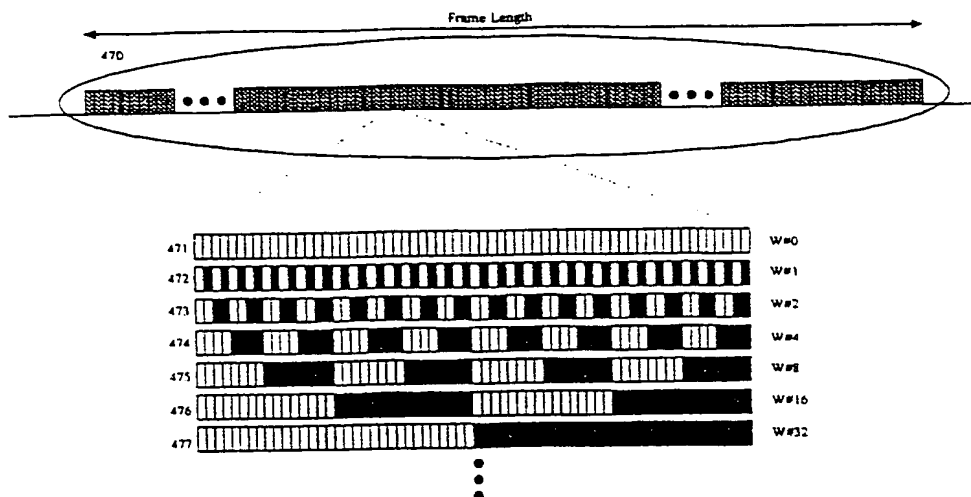


FIG. 4b

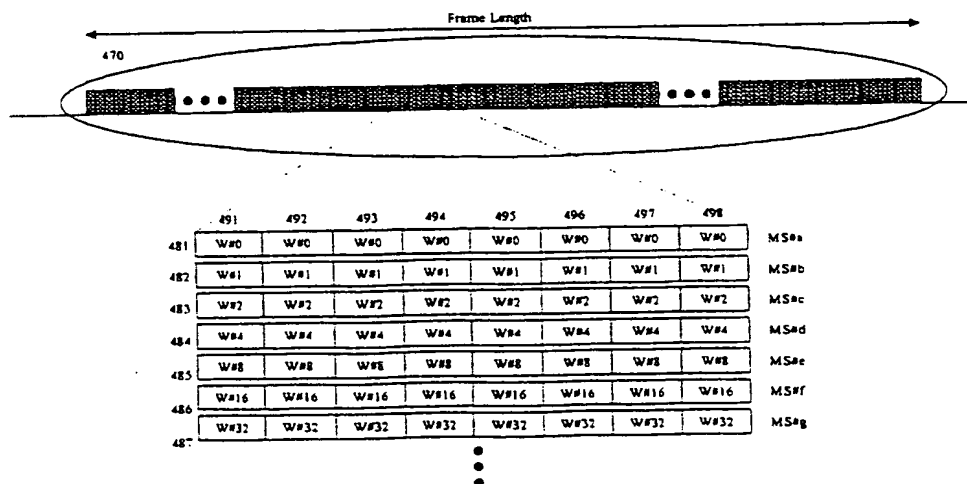


FIG. 4c

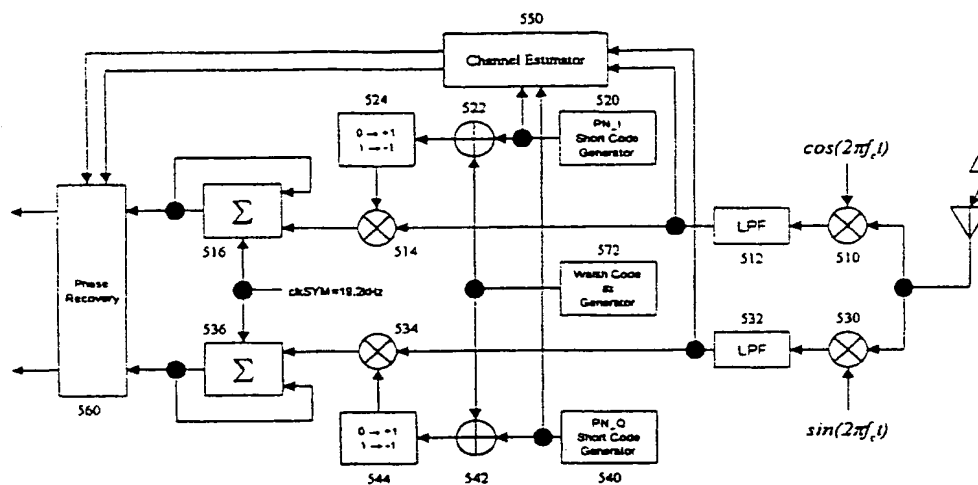


FIG. 5

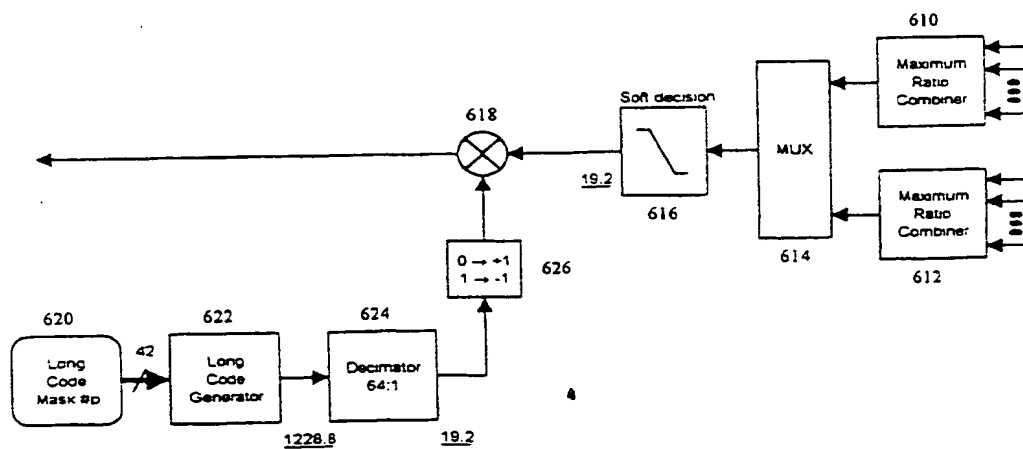


FIG. 6

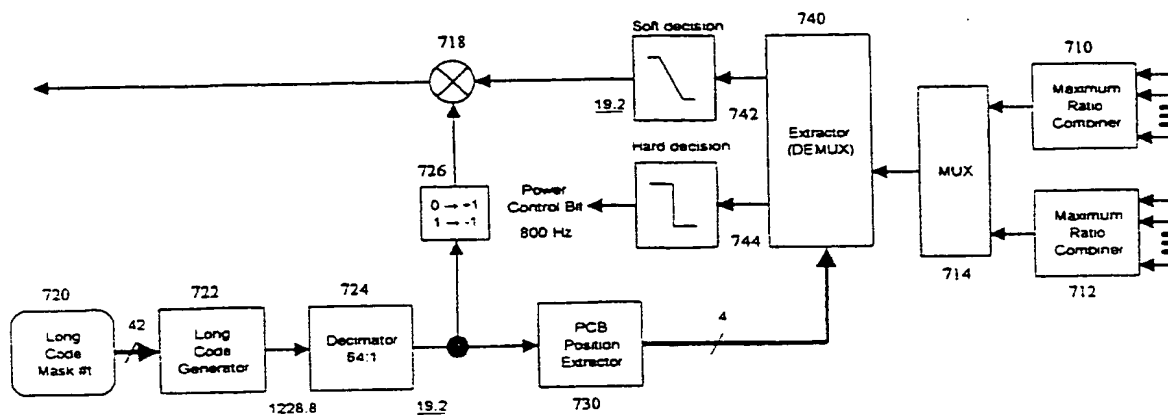


FIG. 7

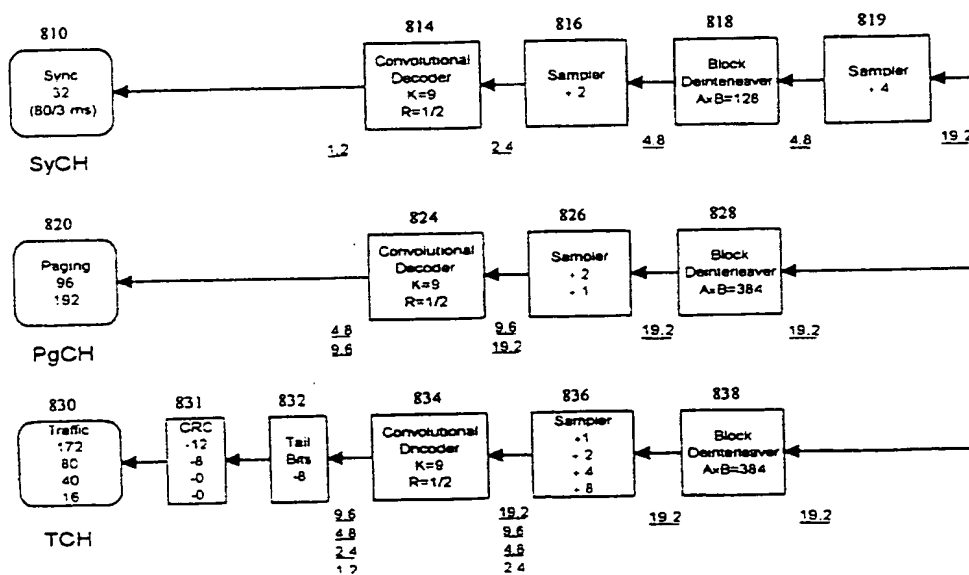


FIG. 8

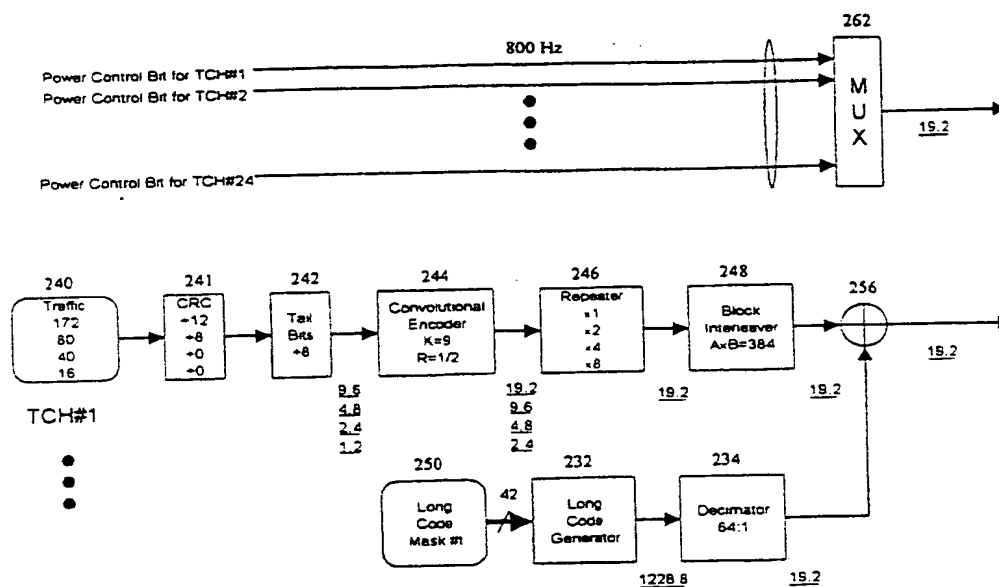


FIG. 9

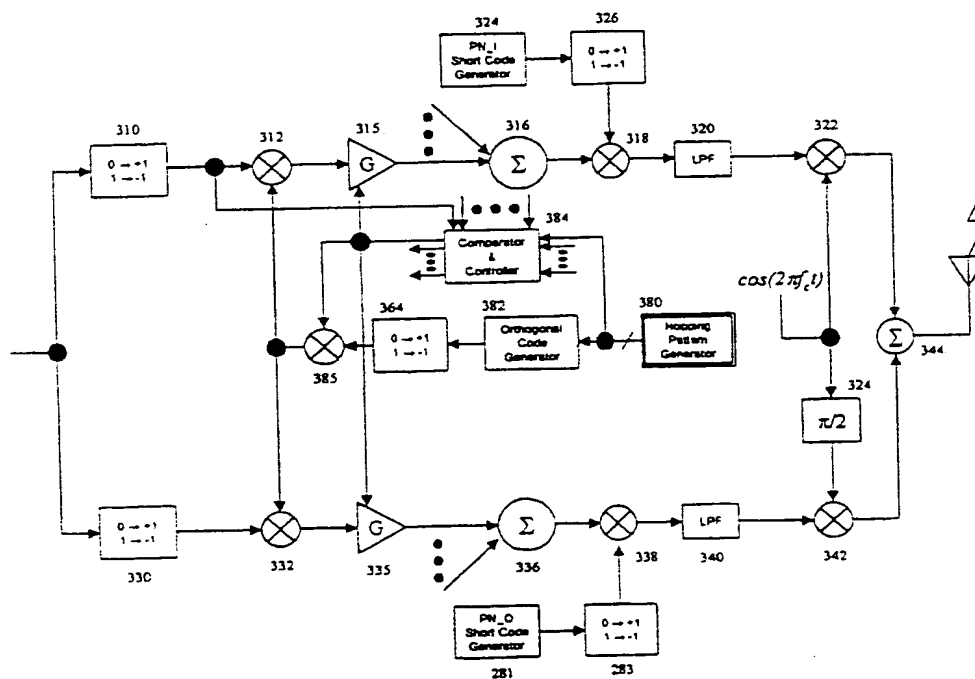


FIG. 10a

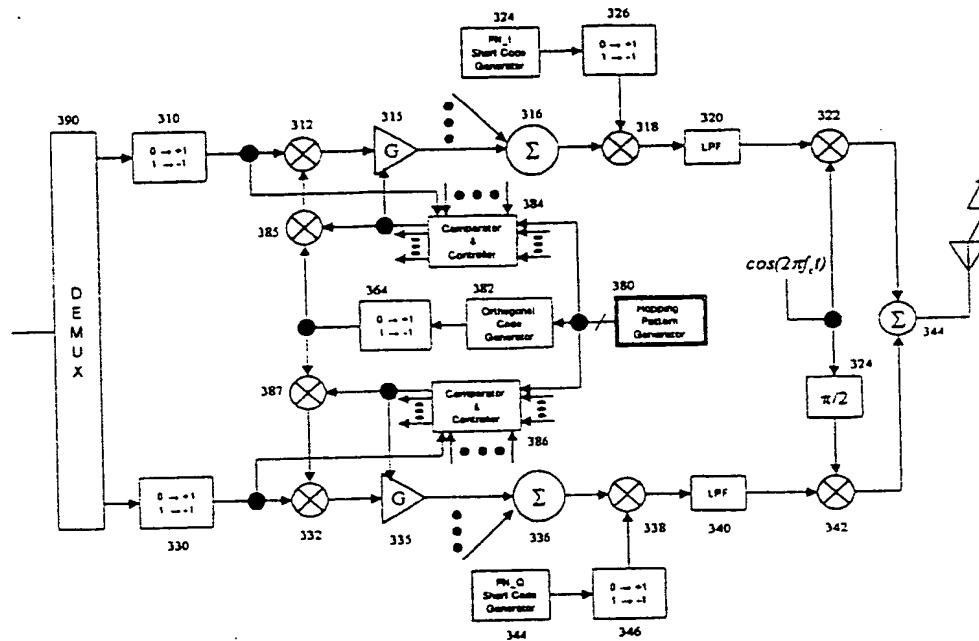


FIG. 10b

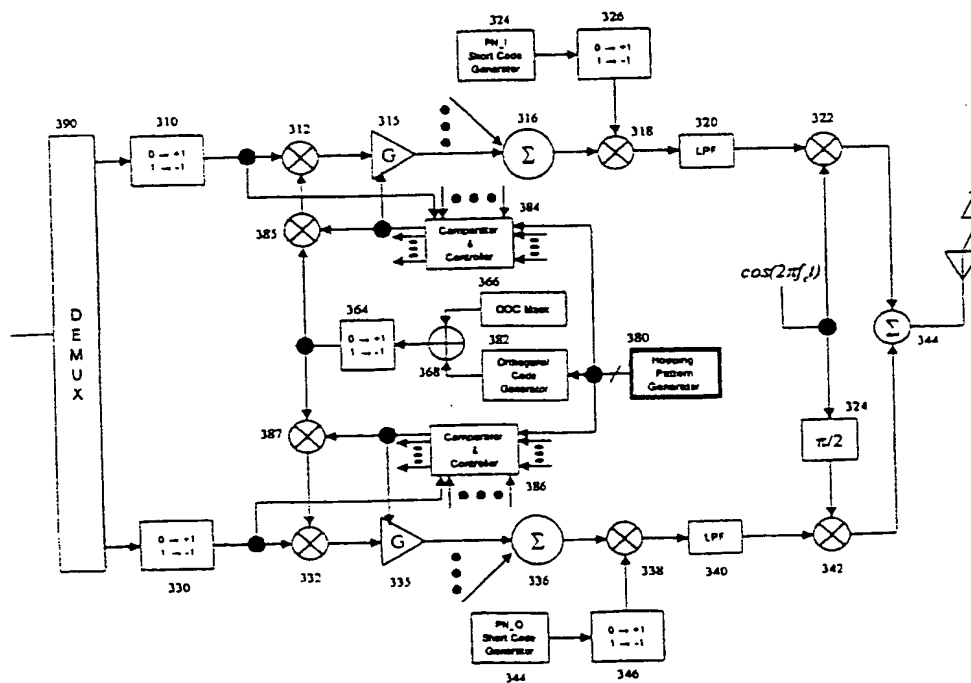


FIG. 10c

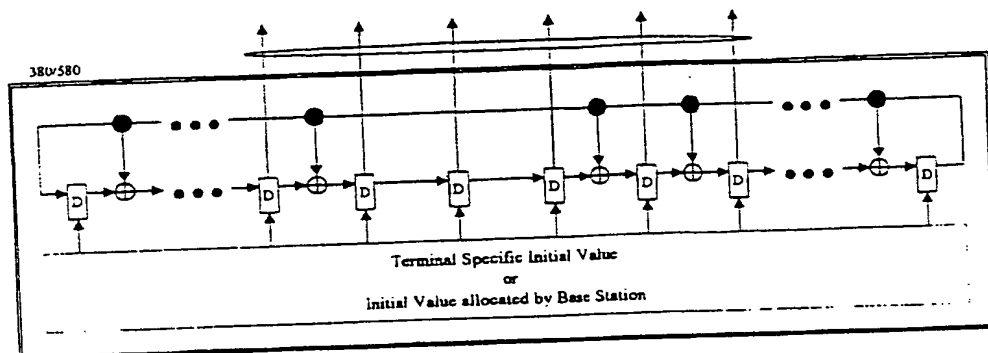


FIG. 11

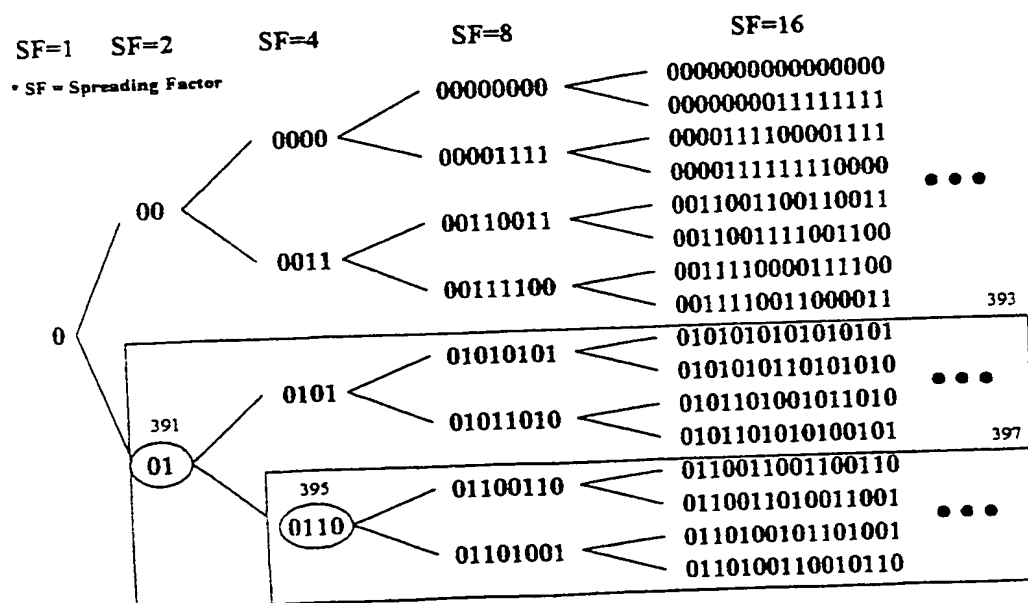


FIG. 12

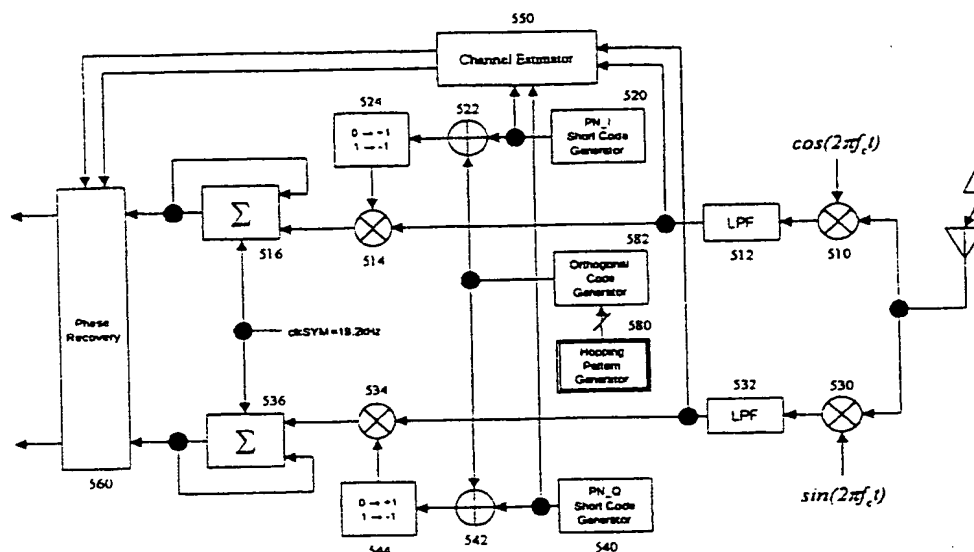


FIG. 13

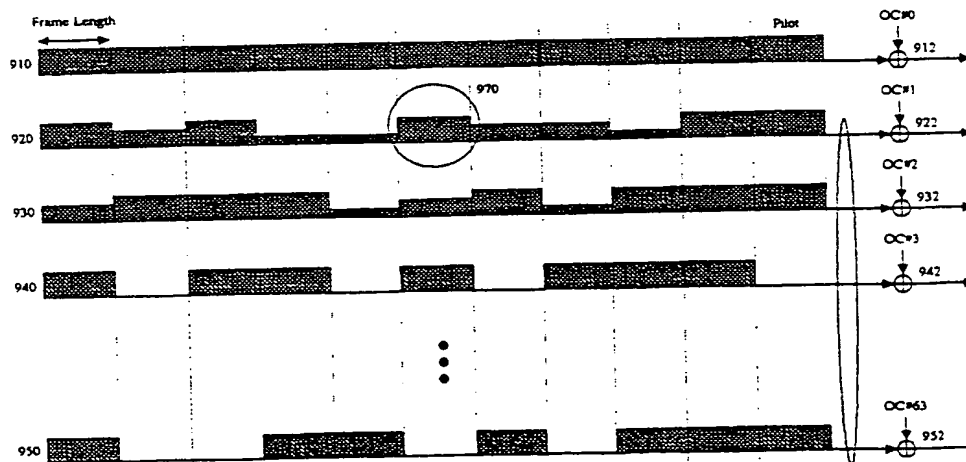


FIG. 14a

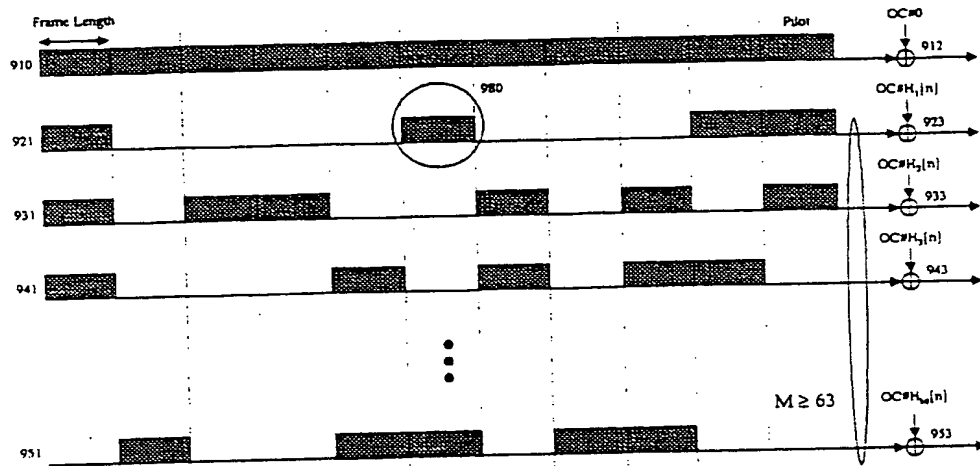


FIG. 14b

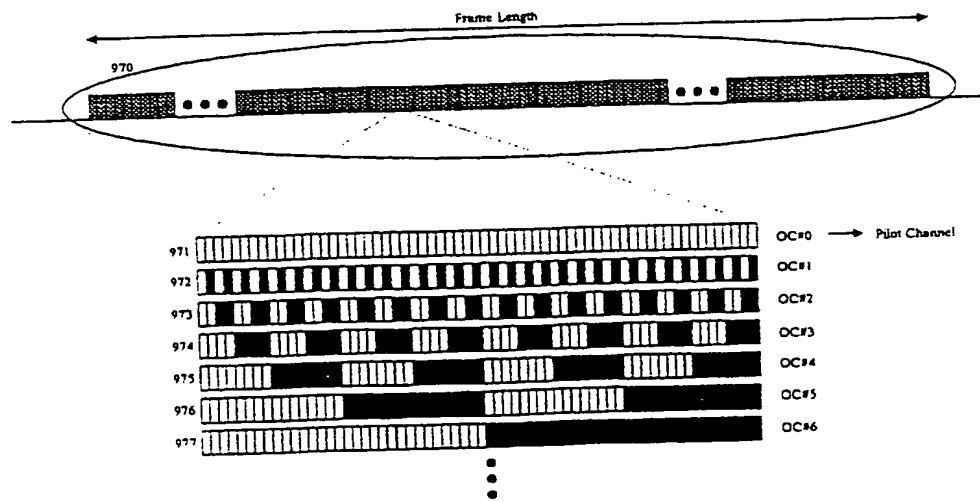


FIG. 14c

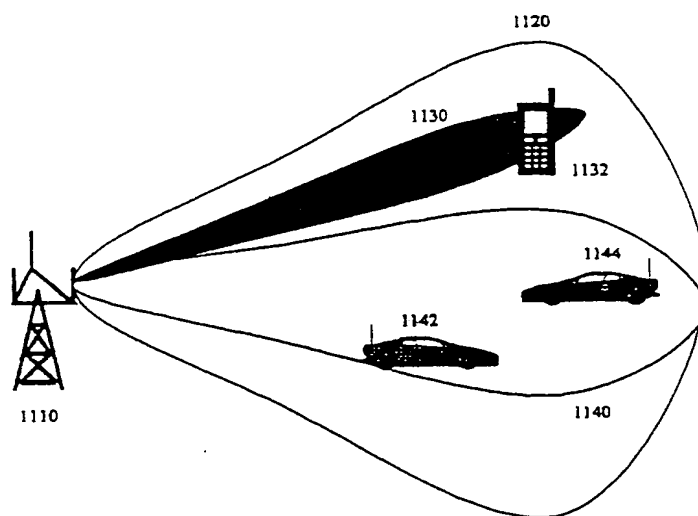


FIG: 15



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/KR 00/00856	International filing date (<i>day/month/year</i>) 3 August 2000 (03.08.2000)	(Earliest) Priority Date (<i>day/month/year</i>) 5 August 1999 (05.08.1999)
Applicant KOREA ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY et al.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (See Box II).

4. With regard to the **title**.

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**.

☐ the text is approved as submitted by the applicant.

☒ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.: 10a

☒ as suggested by the applicant.

☐ None of the figures.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 00/00856

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

Method and apparatus for statistically multiplexing corresponding channels using an orthogonal code hopping in a wire/wireless communication system in which a plurality of synchronized communication channels coexist through one media.

The system including a first communication station and a plurality of second communications includes an orthogonal code hopping pattern generator (380), a spreader (385) for selecting a corresponding orthogonal code symbol in the orthogonal code, a collision comparator & controller (384) for monitoring whether the orthogonal code symbols collide and determining whether the send data symbols to the second communication stations coincide in the collision area, a unit for stopping transmission in case of collision of the hopping patterns and discordance of the transmission data symbols, and a transmission power controller (315, 335) for compensating an average receiving energy loss.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 00/00856

CLASSIFICATION OF SUBJECT MATTER

IPC⁷: H04J 13/06, 11/00; H04B 1/713

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC⁷: H04B, H04J, H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 902 549 A2 (SAMSUNG ELECTRONICS CO LTD) 17 March 1999 (17.03.99) figs.; abstract; sections 3, 4, 13, 14, 20	1-8, 10, 11, 14-20, 35-44
X	GB 2 331 207 A (SAMSUNG ELECTRONICS CO LTD) 12 May 1999 (12.05.99) figs.; abstract; page 1, line 1 - page 5, line 30	1-8, 10, 11, 14-20, 35-44

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

„A“ document defining the general state of the art which is not considered to be of particular relevance

„E“ earlier application or patent but published on or after the international filing date

„L“ document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

„O“ document referring to an oral disclosure, use, exhibition or other means

„P“ document published prior to the international filing date but later than the priority date claimed

„T“ later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

„X“ document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

„Y“ document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

„&“ document member of the same patent family

Date of the actual completion of the international search

11 December 2000 (11.12.2000)

Date of mailing of the international search report

13 February 2001 (13.02.2001)

Name and mailing address of the ISA/AT

Austrian Patent Office
Kohlmarkt 8-10; A-1014 Vienna

Facsimile No. 1/53424/535

Authorized officer

MESA PASCASIO

Telephone No. 1/53424/327

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR 00/00856

Patent document cited in search report			Publication date	Patent family member(s)			Publication date
EP	A2	902549	17-03-1999	CN	A	1278129	27-12-2000
EP	A3	902549	02-11-2000	JP	A2	11163827	18-06-1999
				JP	B2	3093182	03-10-2000
GB	A1	2331207	12-05-1999	CN	A	1211861	24-03-1999
GB	B2	2331207	17-11-1999	GB	A0	9816682	30-09-1998
				JP	A2	11098120	09-04-1999
				SE	A0	9802651	31-07-1998
				SE	A	9802651	01-02-1999

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

REC'D 12 DEC 2001

WIPO

PCT

Applicant's or agent's file reference	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/KR00/00856	International filing date (day/month/year) 03 AUGUST 2000 (03.08.2000)	Priority date (day/month/year) 05 AUGUST 1999 (05.08.1999)
International Patent Classification (IPC) or national classification and IPC IPC7 H04J 13/06, H04J 11/00, H04B 1/713		
Applicant KOREA ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of _____ sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability: citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 26 FEBRUARY 2001 (26.02.2001)	Date of completion of this report 29 NOVEMBER 2001 (29.11.2001)
Name and mailing address of the IPEA/KR Korean Intellectual Property Office Government Complex-Daejeon, Dunsan-dong, Seo-gu, Daejeon Metropolitan City 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer JEONG, Yong Joo Telephone No. 82-42-481-5674



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

P/KR00/00856

1. Basis of the report

1. With regard to the elements of the international application:*

☒ the international application as originally filed☒ the description:pages 1-37 , as originally filed

pages _____ , filed with the demand

pages _____ , filed with the letter of _____

☒ the claims:pages 38-44 , as originally filed

pages _____ , as amended (together with any statement) under Article 19

pages _____ , filed with the demand

pages _____ , filed with the letter of _____

☒ the drawings:pages 1-13 , as originally filed

pages _____ , filed with the demand

pages _____ , filed with the letter of _____

☐ the sequence listing part of the description:

pages _____ , as originally filed

pages _____ , filed with the demand

pages _____ , filed with the letter of _____

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).☐ the language of publication of the international application (under Rule 48.3(b)).☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).3. With regard to any **nucleotide** and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:☐ contained in the international application in written form.☐ filed together with the international application in computer readable form.☐ furnished subsequently to this Authority in written form.☐ furnished subsequently to this Authority in computer readable form.☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.4. ☐ The amendments have resulted in the cancellation of:☐ the description, pages _____☐ the claims, Nos. _____☐ the drawings, sheet _____5. ☐ This opinion has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed," and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims	<u>1 - 44</u>	YES
	Claims	<u>NONE</u>	NO
Inventive step (IS)	Claims	<u>1 - 44</u>	YES
	Claims	<u>NONE</u>	NO
Industrial applicability (IA)	Claims	<u>1 - 44</u>	YES
	Claims	<u>NONE</u>	NO

2. Citations and explanations (Rule 70.7)

Documents cited in the International Search Report :

D1 = EP 902,549

D2 = GB 2,331,207

The claimed invention relates to a method for statistically multiplexing channels by using an orthogonal code hopping in a wire/wireless communications system where a plurality of the channels synchronized through one media and having a low data activity coexist.

The claimed invention is not considered to be anticipated by the patent document cited. None of these documents reveals a method for statistically multiplexing channel by using an orthogonal code hopping in a communications system.

The invention according to the claims 1-44 is therefore considered to be new, to involve an inventive step and to be industrially applicable.

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To:

LEE, Jong Il

#904 BYC Bldg., 648-1, Yoksam-dong, Kangnam-ku, Seoul
135-080, Republic of Korea

PCT

NOTIFICATION OF RECEIPT OF DEMAND BY COMPETENT INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

(PCT Rule 59.3(e) and 61.1(b), first sentence
and Administrative Instructions, Section 601(a))

Date of mailing
(day/month/year) 06 MARCH 2001 (06.03.2001)

Applicant's or agent's file reference

IMPORTANT NOTIFICATION

International application No.

PCT/KR00/00856

International filing date (day/month/year)

03 AUGUST 2000 (03.08.2000)

Priority date (day/month/year)

05 AUGUST 1999 (05.08.1999)

Applicant

KOREA ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY et al

1. The applicant is hereby notified that this International Preliminary Examining Authority considers the following date as the date of receipt of the demand for international preliminary examination of the international application:

26 FEBRUARY 2001 (26.02.2001)

2. This date of receipt is :

- ☒ the actual date of receipt of the demand by this Authority (Rule 61.1(b)).
- ☐ the actual date of receipt of the demand on behalf of this Authority (Rule 59.3(e)).
- ☐ the date on which this Authority has, in response to the invitation to correct defects in the demand (Form PCT/IPEA/404), received the required corrections.

3. ☐ **ATTENTION:** That date of receipt is **AFTER** the expiration of 19 months from the priority date. Consequently, the election(s) made in the demand does (do) not have the effect of postponing the entry into the national phase until 30 months from the priority date (or later in some Offices) (Article 39(1)). Therefore, the acts for entry into the national phase must be performed within 20 months from the priority date (or later in some Offices) (Article 22). For details, see the *PCT Applicant's Guide*, Volume II.

- ☐ (If applicable) This notification confirms the information given by telephone, facsimile transmission or in person on:

4. Only where paragraph 3 applies, a copy of this notification has been sent to the International Bureau.

Name and mailing address of the IPEA/KR

Korean Industrial Property Office
Government Complex-Taejon, Dunsan-dong, So-ku, Taejon
Metropolitan City 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

COMMISSIONER

Telephone No. 82-42-481-5210



PATENT COOPERATION TREATY

PCT

NOTIFICATION CONCERNING
SUBMISSION OR TRANSMITTAL
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

From the INTERNATIONAL BUREAU


To:

LEE, Jong-Il
904 Byc Bldg.
648-1 Yoksam-dong
Kangnam-ku
Seoul 135-080
RÉPUBLIQUE DE CORÉE

Date of mailing (day/month/year) 01 September 2000 (01.09.00)	
Applicant's or agent's file reference	IMPORTANT NOTIFICATION
International application No. PCT/KR00/00856	International filing date (day/month/year) 03 August 2000 (03.08.00)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 05 August 1999 (05.08.99)
Applicant KOREA ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY et al	

- The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
- This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.
- An asterisk(*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
- The letters "NR" appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

<u>Priority date</u>	<u>Priority application No.</u>	<u>Country or regional Office or PCT receiving Office</u>	<u>Date of receipt of priority document</u>
05 Augu 1999 (05.08.99)	1999/32187	KR	15 Augu 2000 (15.08.00)

<p>The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland</p> <p>Facsimile No. (41-22) 740.14.35</p>	<p>Authorized officer</p> <p>Anman QIU </p> <p>Telephone No. (41-22) 338.83.38</p>
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PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum)

Box No. I TITLE OF INVENTION

METHOD AND APPARATUS FOR ORTHOGONAL CODE HOPPING
MULTIPLEXING COMMUNICATIONS

Box No. II APPLICANT

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

KOREA ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY

#373-1 Kusong-dong, Yusong-gu, Taejon, 305-701
Republic of Korea

☐ This person is also inventor.

Telephone No.:

Facsimile No.:

Teleprinter No.:

State (that is, country) of nationality

KR

State (that is, country) of residence

KR

This person is applicant for the purposes of:

☐ all designated States

☒ all designated States except the United States of America

☐ the United States of America only

☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

SUNG, Dan-Keun

#1503-103 Hanwool APT., shinsung-dong, Yusong-gu.,
Taejon, 305-035
Republic of Korea

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only (if this check-box is amended, do not fill in below)

State (that is, country) of nationality

KR

State (that is, country) of residence

KR

This person is applicant for the purposes of:

☐ all designated States

☐ all designated States except the United States of America

☒ the United States of America only

☐ the States indicated in the Supplemental Box

☒ Further applicants are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:

☒ agent

☐ common representative

Name and address: (Family name followed by given name; for a legal entity full official designation. The address must include postal code and name of country.)

LEE, Jong-Il

#904 Byc Bldg., 648-1, Yoksam-dong, Kangnam-ku,
Seoul, 135-080
Republic of Korea

Telephone No.:

82-2-554-3026

Facsimile No.:

82-2-554-3026

Teleprinter No.:

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR FURTHER INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: Family name followed by given name for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.

PARK, Su-won

#673-1, Kusong-dong, Yusong-gu, Taejeon, 305-701
Republic of Korea

This person is:

- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only (if this check-box is amended, do not fill in below)

State (that is, country) of nationality

KR

State (that is, country) of residence

KR

This person is applicant for the purposes of:

- ☐ all designated States
- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

Name and address: Family name followed by given name for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.

This person is:

- ☐ applicant only
- ☐ applicant and inventor
- ☐ inventor only (if this check-box is amended, do not fill in below)

State (that is, country) of nationality

State (that is, country) of residence

This person is applicant for the purposes of:

- ☐ all designated States
- ☐ all designated States except the United States of America
- ☐ the United States of America only
- ☐ the States indicated in the Supplemental Box

Name and address: Family name followed by given name for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.

This person is:

- ☐ applicant only
- ☐ applicant and inventor
- ☐ inventor only (if this check-box is amended, do not fill in below)

State (that is, country) of nationality

State (that is, country) of residence

This person is applicant for the purposes of:

- ☐ all designated States
- ☐ all designated States except the United States of America
- ☐ the United States of America only
- ☐ the States indicated in the Supplemental Box

Name and address: Family name followed by given name for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.

This person is:

- ☐ applicant only
- ☐ applicant and inventor
- ☐ inventor only (if this check-box is amended, do not fill in below)

State (that is, country) of nationality

State (that is, country) of residence

This person is applicant for the purposes of:

- ☐ all designated States
- ☐ all designated States except the United States of America
- ☐ the United States of America only
- ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No. 7 DESIGNATION OF STATES

The following designations are hereby made under Rule 49(a): mark the applicable check-box(es); at least one must be marked:

Regional Patent

- ☐ AP ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, MZ Mozambique, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☐ EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☐ EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☐ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Cote d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)


National Patent (if other kind of protection or treatment desired, specify on dotted line):

- | | |
|---|---|
| <input type="checkbox"/> AE United Arab Emirates | <input type="checkbox"/> LC Kazakhstan |
| <input type="checkbox"/> AG Antigua and Barbuda | <input type="checkbox"/> LK Sri Lanka |
| <input type="checkbox"/> AL Albania | <input type="checkbox"/> LR Liberia |
| <input type="checkbox"/> AM Armenia | <input type="checkbox"/> LS Lesotho |
| <input type="checkbox"/> AT Austria | <input type="checkbox"/> LT Lithuania |
| <input type="checkbox"/> AU Australia | <input type="checkbox"/> LU Luxembourg |
| <input type="checkbox"/> AZ Azerbaijan | <input type="checkbox"/> LV Latvia |
| <input type="checkbox"/> BA Bosnia and Herzegovina | <input type="checkbox"/> MA Morocco |
| <input type="checkbox"/> BB Barbados | <input type="checkbox"/> MD Republic of Moldova |
| <input type="checkbox"/> BG Bulgaria | <input type="checkbox"/> MG Madagascar |
| <input type="checkbox"/> BR Brazil | <input type="checkbox"/> MK the former Yugoslav Republic of Macedonia |
| <input type="checkbox"/> BY Belarus | <input type="checkbox"/> MN Mongolia |
| <input type="checkbox"/> BZ Belize | <input type="checkbox"/> MW Malawi |
| <input type="checkbox"/> CA Canada | <input type="checkbox"/> MX Mexico |
| <input type="checkbox"/> CH and LI Switzerland and Liechtenstein | <input type="checkbox"/> MZ Mozambique |
| <input type="checkbox"/> CN China | <input type="checkbox"/> NO Norway |
| <input type="checkbox"/> CR Costa Rica | <input type="checkbox"/> NZ New Zealand |
| <input type="checkbox"/> CU Cuba | <input type="checkbox"/> PL Poland |
| <input type="checkbox"/> CZ Czech Republic | <input type="checkbox"/> PT Portugal |
| <input type="checkbox"/> DE Germany | <input type="checkbox"/> RO Romania |
| <input type="checkbox"/> DK Denmark | <input type="checkbox"/> RU Russian Federation |
| <input type="checkbox"/> EE Estonia | <input type="checkbox"/> SD Sudan |
| <input type="checkbox"/> ES Spain | <input type="checkbox"/> SE Sweden |
| <input type="checkbox"/> DM Dominica | <input type="checkbox"/> SG Singapore |
| <input type="checkbox"/> DZ Algeria | <input type="checkbox"/> SI Slovenia |
| <input type="checkbox"/> FI Finland | <input type="checkbox"/> SK Slovakia |
| <input type="checkbox"/> GB United Kingdom | <input type="checkbox"/> SL Sierra Leone |
| <input type="checkbox"/> GD Grenada | <input type="checkbox"/> TJ Tajikistan |
| <input type="checkbox"/> GE Georgia | <input type="checkbox"/> TM Turkmenistan |
| <input type="checkbox"/> GH Ghana | <input type="checkbox"/> TR Turkey |
| <input type="checkbox"/> GM Gambia | <input type="checkbox"/> TT Trinidad and Tobago |
| <input type="checkbox"/> HR Croatia | <input type="checkbox"/> TZ United Republic of Tanzania |
| <input type="checkbox"/> HU Hungary | <input type="checkbox"/> UA Ukraine |
| <input type="checkbox"/> ID Indonesia | <input type="checkbox"/> UG Uganda |
| <input type="checkbox"/> IL Israel | <input checked="" type="checkbox"/> US United States of America |
| <input type="checkbox"/> IN India | <input type="checkbox"/> UZ Uzbekistan |
| <input type="checkbox"/> IS Iceland | <input type="checkbox"/> VN Viet Nam |
| <input type="checkbox"/> JP Japan | <input type="checkbox"/> YU Yugoslavia |
| <input type="checkbox"/> KE Kenya | <input type="checkbox"/> ZA South Africa |
| <input type="checkbox"/> KG Kyrgyzstan | <input type="checkbox"/> ZW Zimbabwe |
| <input type="checkbox"/> KP Democratic People's Republic of Korea | |
| <input type="checkbox"/> KR Republic of Korea | |
| <input type="checkbox"/> KZ Kazakhstan | |

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:

☐

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 49(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)

Box No. VI PRIORITY CLAIM		<input type="checkbox"/> Further priority claims are indicated in the Supplement Box.		
Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is		
		national application: country	regional application:* regional Office	international application: receiving Office
item(1) 05 August 1999 (05. 08. 99)	1999-32187	KR		
item(2)				
item(3)				
<input type="checkbox"/> The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s):				
* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplementary Box at least one country party to the Paris convention for the Protection of Industrial Property for which that earlier application was filed Rule 4.10(b)(ii) See Supplemental Box.				
Box No. VII INTERNATIONAL SEARCHING AUTHORITY				
Choice of International Searching Authority (ISA) (if two or more International Searching Authorities are competent to carry the international search, indicate the Authority chosen, the two-letter code may be used):		Request to use the results of earlier search: reference to that search (if an earlier search has been carried out or requested from the International Searching Authority):		
ISA/ AT		Date(day/month/year) Number Country(or regional Office)		
Box No. VIII CHECK LIST; LANGUAGE OF FILING				
This international application contains the following number of sheets:		This international application is accompanied by the item(s) marked below:		
request : 4		1. <input checked="" type="checkbox"/> fee calculation sheet		
description(excluding sequence listing part) : 37		2. <input type="checkbox"/> separate signed power of attorney		
claims : 13		3. <input type="checkbox"/> copy of general power of attorney; reference number, if any:		
abstract : 1		4. <input type="checkbox"/> statement explaining lack of signature		
drawings :		5. <input type="checkbox"/> priority document(s) identified in Box No. VI as item(s)		
sequence listing part of description :		6. <input type="checkbox"/> translation of international application into(language)		
Total number of sheets : 54		7. <input type="checkbox"/> separate indications concerning deposited microorganism or other biological material		
		8. <input type="checkbox"/> nucleotide and/or amino acid sequence listing in computer reader form		
		9. <input type="checkbox"/> other(specify) :		
Figure of the drawings which should accompany the abstract: 10a		Language of filing of the international application: English		
Box No. IX SIGNATURE OF APPLICANT OR AGENT				
Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).				
LEE, Jong 				

1. Date of actual receipt of the purported international application :	2. Drawings:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application :	<input type="checkbox"/> received:
4. Date of timely receipt of the required corrections under PCT Article 11(2) :	<input type="checkbox"/> not received:
5. International Searching Authority (if two or more are competent) : ISA/	6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid

Date of receipt of the record copy
by the International Bureau:

For International Bureau use only

PCT

FEE CALCULATION SHEET

Annex to the Request

For receiving Office use only

International application No.

Date stamp of the receiving Office

Applicant's or agent's
file reference

Applicant

KOREA ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY

CALCULATION OF PRESCRIBED FEES

1. TRANSMITTAL FEE 45.000 T

2. SEARCH FEE 171.500 S

International search to be carried out by AT

(If two or more International Searching Authorities are competent in relation to the international application, indicate the name of the Authority which is chosen to carry out the international search)

3. INTERNATIONAL FEE

Basic Fee

The international application contains 68 sheets.

first 30 sheets 451.600 b1

38 remaining sheets x 10.400 additional amount = 395.200 b2

Add amounts entered at b1 and b2 and enter total at B 846.800 B

Designation Fees

The international application contains 33 designations.

3 x 27.300 = 778.400 D

number of designation fees payable (maximum 3) amount of designation fee

Add amounts entered at B and D and enter total I 1.625.200 I

(Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is or all applicants are so entitled, the total to be entered at I is 25% of the sum of the amounts entered at B and D)

4. FEE FOR PRIORITY DOCUMENT if applicable: P

5. TOTAL FEES PAYABLE 1.841.700

Add amounts entered at T, S, I and P and enter total in the TOTAL box TOTAL

☐ The designation fees are not paid at this time.

MODE OF PAYMENT

☐ Authorization to charge deposit account (see below) ☐ bank draft ☐ coupons
☐ cheque ☒ cash ☐ other (specify)
☐ postal money order ☐ revenue stamps

DEPOSIT ACCOUNT AUTHORIZATION (this mode of payment may not be available at all receiving Offices)

The RO/ ☐ is hereby authorized to charge the total fees indicated above to my deposit account.

☐ (this check-box may be marked only if the conditions for deposit accounts of the receiving Office so permit) is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.

☐ is hereby authorized to charge the fee for preparation and transmittal of the priority document to the International Bureau of WIPO to my deposit account.

Deposit Account Number: Date (day/month/year): signature